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FEBRUARY, 1957

Petroleum Processing

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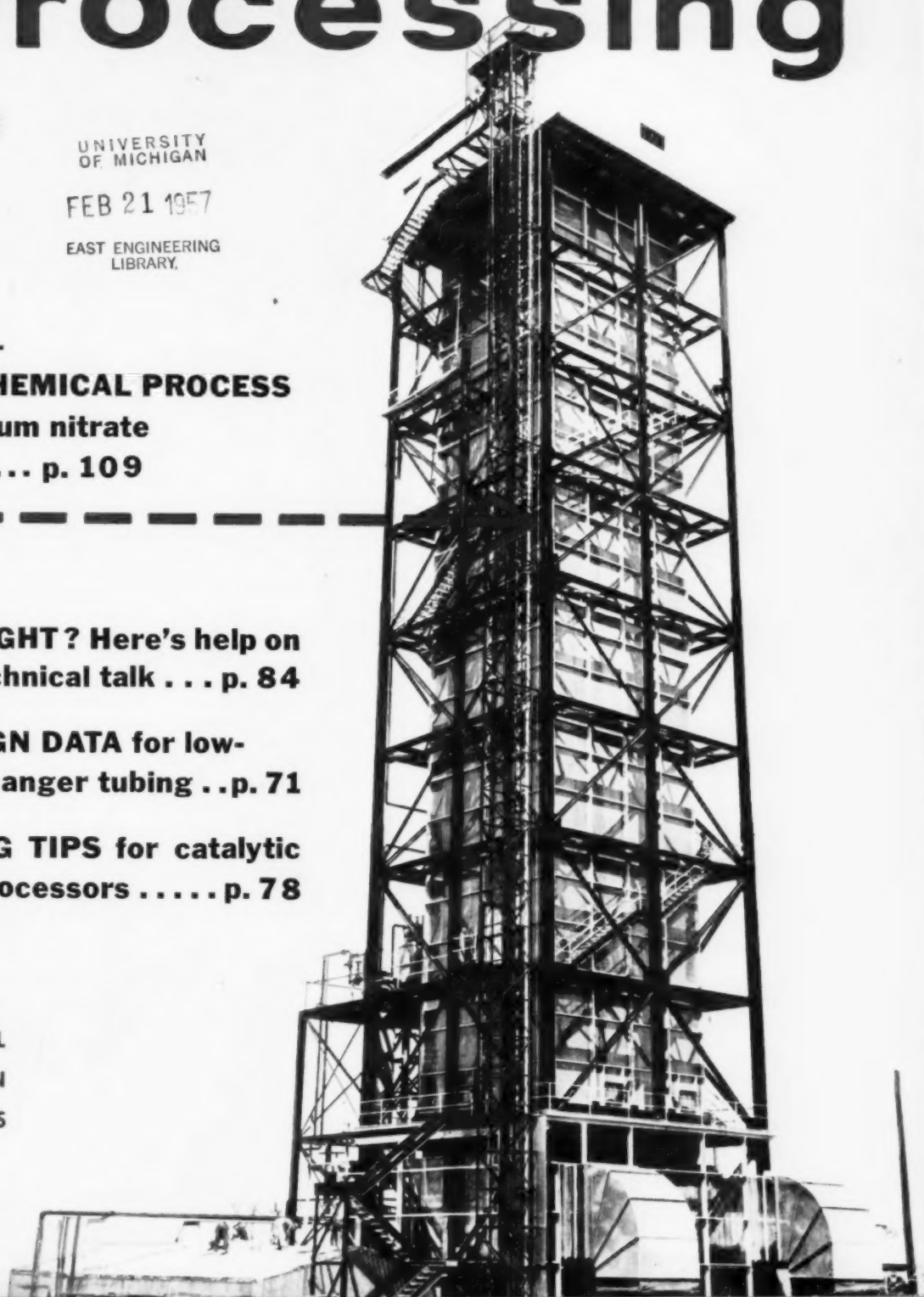

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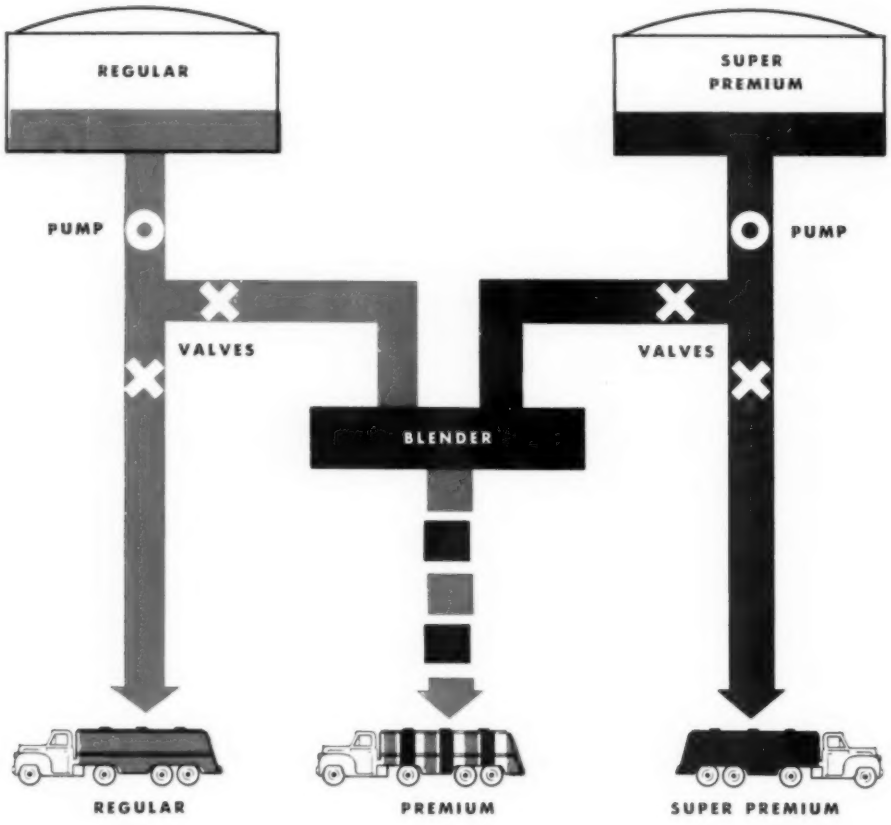

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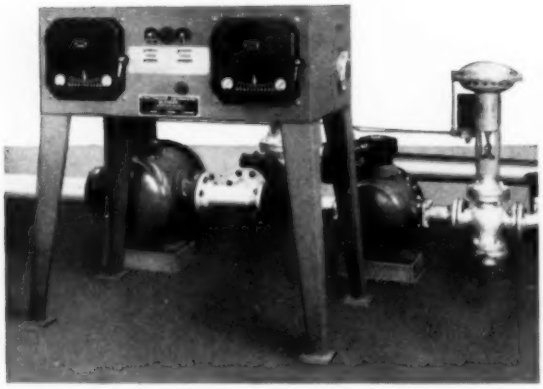

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Dear Reader...

. . . Ever been told, "You're nuts". Have you ever had an idea you were convinced was dead right, only to hear everyone tell you it was dead wrong?

Of course you have. And that's what we've been going through ourselves the past few months.

We're still convinced we're right and are going to do something about it. The idea is a plan we've inaugurated to publish a series of articles during coming months on a subject we've chosen to call "self development." You read the first article last month, "What Do Oilmen Want in the Technical Man (Besides Ability)?" and there's another one on the problem of public speaking in this issue, p. 84.

The point is that many of you have indicated to us—in personal interviews, in correspondence, and through readership surveys—that you are NOT particularly interested in this type of reading matter. We're a bit obstinate—maybe even a little bit ornery. We think you should be interested. Further than that, we're willing to bet you will be interested, especially after you've read a few of these pieces.

Many of the articles will be written for you by specialists in their fields. Some will be written by our own staff man, Stuart D. Boynton, whose project this is.

Like all our staffers, Stu had an idea. He was sold on it. Then he had to sell us on it. Once he had us convinced, we threw it right back into Stu's lap, saying, "OK, if you feel this is really so hot, go ahead and do something about it." Stu soon learned in a survey of management thinking that—whether you like it or not—management IS interested in a well-rounded engineer, management DOES want more than technical skills in top level posts, management WILL chose men for top jobs who have supplemented their technical knowledge with new non-technical skills.

These skills that management wants are: 1) ability to communicate well, 2) getting along with others, 3) supervisory skill, 4) salesmanship, 5) concern for and care of health.

This information charted Stu's course quite clearly. It is now up to him—and PETROLEUM PROCESSING—to provide you with articles aimed at helping you.

This month's article on speaking falls into the first area—improved communication. It was prepared by a man who is no stranger to the petroleum industry, having taught public speaking to oil company employes. Watch for others in future issues.

Bill Uhl

—Managing Editor

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WHAT'S HAPPENING

. . . in Refining

. . . **The Texas Co.** will start construction March 1 of new 40,000 b/d refinery near Anacortes, Wash. Contracts for general construction of plant were awarded to Bechtel Corp., with completion target of Jan, 1959. Units include an 18,000 b/d fluid cat cracker, 7000 b/d cat reformer, cat poly, alkylation, and hydrotreating.

. . . **Delta Refining Co.** plans a Girbotol unit to remove 10,000 lb/d of hydrogen sulfide from 1500 b/d liquid, propane-butane mixture at Memphis, Tenn. The Girdler Co. will design and build the unit, due onstream February, 1957.

. . . **Costly fires hit two refiners** since first of year: on Jan. 30, a 5000-b/d alkylation unit at Standard Oil (Ind.), Whiting, to tune of about $1-million, and Jan. 8, an estimated $3-million damage to main pump house and six storage tanks of Shell Oil of Canada, at Montreal East, Que.

. . . **Imperial Oil Ltd.** plans another Powerformer (see PETROLEUM PROCESSING, Oct., 1956, p. 9). The new $4-million project at Winnipeg, Manitoba, will include the Powerformer, prefractionator and Hydrofiner to be built by Foster Wheeler Corp.

. . . **Magnolia Petroleum Co.** plans a 100,000 b/d crude oil distillation unit at Beaumont, Texas. Foster Wheeler Corp. will build the unit, with completion due mid-'58.

. . . **Richfield Oil Co.** has assembled, by purchase and option, about 1000 acres on the Puget Sound 14 miles northwest of Everett, Wash., for a refinery site.

. . . **Royalite Oil Co.** plans a 20,000 b/d processing plant at Mildred Lake, halfway between Bitumount and Fort McMurray, to separate oil from the Athabasca oil sands of northern Alberta (see PETROLEUM PROCESSING, Dec., 1956, p. 12). Heart of the $50-million project will be the Coulson centrifuge process perfected jointly with Can-Amera Oil Sands Development Co. Construction by Caribou Engineering Co. of Calgary will begin this spring, with completion schedule for 1960.

. . . **Gulf Oil Corp.** will exercise its option on a 280-acre tract near Charleston, S.C., as a tentative location for a new refinery.

. . . **British American Oil Co.** has given contract to Lummus Co. of Canada Ltd. to build a 6000 b/sd catalytic reformer. Completion is due late-'57.

. . . **Standard Oil Co. (Ohio)** has signed a $34-million contract with M. W. Kellogg Co. for new refining facilities at the Toledo, Ohio, refinery (see PETROLEUM PROCESSING, Dec., 1956, p. 9). Work will start spring-'57 and is due to be completed by April, 1958. This project will bring the Toledo refinery's rated capacity up to 60,000 b/d, a net gain of 32,000 b/d.

. . . **Shell Oil Co.** has contracted for Kaiser Engineers Div. of the H. J. Kaiser Co. to build a 12,000 b/d desulfurizer-Platformer unit at the Wilmington-Dominguez, Calif., refinery.

. . . **Shell Oil Co.** has contracted with Fluor Corp., Ltd. to build a 2400 b/d, sulfuric acid alkylation plant at Shell's Anacortes, Wash., refinery. Completion of the $5-million unit is scheduled in mid-'58.

. . . **Shell Oil Co. of Canada** has contracted for Refinery Engineering, Ltd. to erect a 1500 b/d HF alkylation unit at Shell's Montreal East, Que., refinery. Process design is by Shell and Universal Oil Products Co.

. . . **Standard Oil Co. (Ind.)** plans to make aviation jet fuel at its Mandan, N.D., refinery. Production will start early-'58, with an ultimate capacity of 1-million b/yr planned.

. . . **Standard Oil Co. (Ind.)** will build its third Ultraformer at the Whiting, Ind., refinery. Arthur G. McKee Co. is the prime contractor for the 21,000 b/d unit expected in operation early-'58.

. . . **Socony Mobil Oil Co., Inc.** has plans for new process units at four refineries:

- M. W. Kellogg will erect a 2435 b/sd sulfuric alkylation plant at Socony's Buffalo, N.Y., refinery.
- Fluor Corp., Ltd. has the contract for a 3500 b/sd sulfuric acid alkylation unit at Socony's Trenton, Mich., refinery. The unit will cost $3.5-million and is due onstream early-'58.
- J. F. Pritchard & Co. will build a Socony-designed, platinum-alumina catalyst catalytic reformer of 9000 b/sd capacity at Socony's Augusta, Kans., refinery.
- Two new units, a 3000 b/d catalytic reformer and pretreater, and a 3350 b/d hydrodesulfurization unit for heating oil and other distillate fuels will be built at Socony's Casper, Wyo., refinery by J. F. Pritchard & Co.

. . . **U.S. Oil & Refining Co.** will have Holmes & Narver (Los Angeles) install a 2500-3000 b/d Houdriformer at U.S.'s Tacoma, Wash., refinery. Completion is due May, 1957.

. . . **Other new construction projects,** indicated by recent fast tax write-off approvals, are:

- The Texas Co., $4,520,200 for oil refining facilities at Los Angeles, Calif.

- Esso Standard Oil Co., $4,336,000 for oil refining facilities at Bayway (Linden), N.J.
- Socony Mobil Oil Co., Inc., $4,847,000 for oil refining facilities at East St. Louis, Ill.
- California Oil Co., $1,260,000 for expansion of cat reformer at Perth Amboy, N.J.

. . . in Gas Liquids Recovery

. . . **El Paso Natural Gas Co.** has temporary approval from the Federal Power Commission to buy the McElroy-Wilshire gasoline plant from Lone Star Producing Co. El Paso and Hunt Oil Co. will pay half the cost of acquiring the Upton County, Texas, plant, and will jointly build new gathering lines.

. . . **The newly-authorized New Hope Deep Unit** cycling project, for the New Hope field of Northeast Texas, is expected to recover up to 80-million bbl of condensate from the Smackover lime. Initial capacity will be 5-million cu ft/day of gas with Tidewater Oil Co. (the unit operator) estimating a liquid recovery of 170 bbl/million cu ft.

. . . in Petrochemicals

. . . **Calcasieu Chemical Corp.** will own a $11-million plant at Lake Charles, La., to produce ethylene oxide and ethylene glycol (8-million gal/yr of glycol). The plant, to be engineered, built and operated for Calcasieu by Petroleum Chemicals, Inc., is due onstream early-'58.

. . . **Carbide Chemicals Co.** will double polyethylene and ethylene glycol capacities originally planned for Montreal East with completion scheduled for spring-'57.

. . . **Celanese Corp. of America** plans to build a 15-million lb/yr acrylate plant to upgrade its present production of formaldehyde, methanol, butanol and glacial acetic acid.

. . . **Polymer Corp.** will build a $30-million synthetic rubber plant near Red Deer, Alta.

. . . **Allied Chemical & Dye Corp.** will nearly double its present 30-million lb/yr synthetic phenol capacity at Frankford, Pa.

. . . **American Oil Co.** has given Fluor Corp., Ltd. a contract to build facilities for gas treating and 50 t/d sulfur recovery at American's Yorktown, Va., refinery.

. . . **Ashland Oil & Refining Co.** plans to spend about $10-million in its 1957 fiscal year on a start in petrochemicals manufacture and additional refinery facilities.

. . . **Du Pont's Polychemicals Department** has purchased 600 acres on the Mississippi River 27 miles upstream from New Orleans for "possible future expansion."

. . . **W. R. Grace & Co.** plans a $25-million plant at Memphis, Tenn., to produce acetylene.

. . . **Humble Oil & Refining Co.**'s new 24-million gal/yr benzene recovery unit due onstream in Dec., 1957 (see PETROLEUM PROCESSING, Dec., 1956, p. 10) will be handled by Badger Mfg. Co. using Universal Oil Products Co.'s Udex Process.

. . . **Humble Oil & Refining Co.**'s low-temperature fractionation unit (reported in PETROLEUM PROCESSING, Jan., 1957, p. 10) will make 80-million lb/yr ethylene from refinery gases at Baytown, Texas. Completion is scheduled by mid-'58.

. . . **Petroleum Chemicals, Inc.** will build the first butyl rubber plant since World War II. Location of the $17-million, 30,000 t/yr plant will be at Lake Charles, La. Foster Wheeler will build the plant, with operation scheduled before Jan., 1959.

. . . **Quebec Ammonia Co. Ltd.** will build a $9-million ammonia plant near Brockville, Ont.

. . . **Shell Chemical Corp.** will increase isopropyl alcohol production 120-million lb/yr when it completes a two-stage expansion of plants in Houston, Texas; Norco, La.; and Dominguez, Calif.

. . . **Texas Eastman Co.** plans to increase polyethylene production above the present 55-million lb/yr capacity at its Longview, Texas, plant.

. . . in Transition

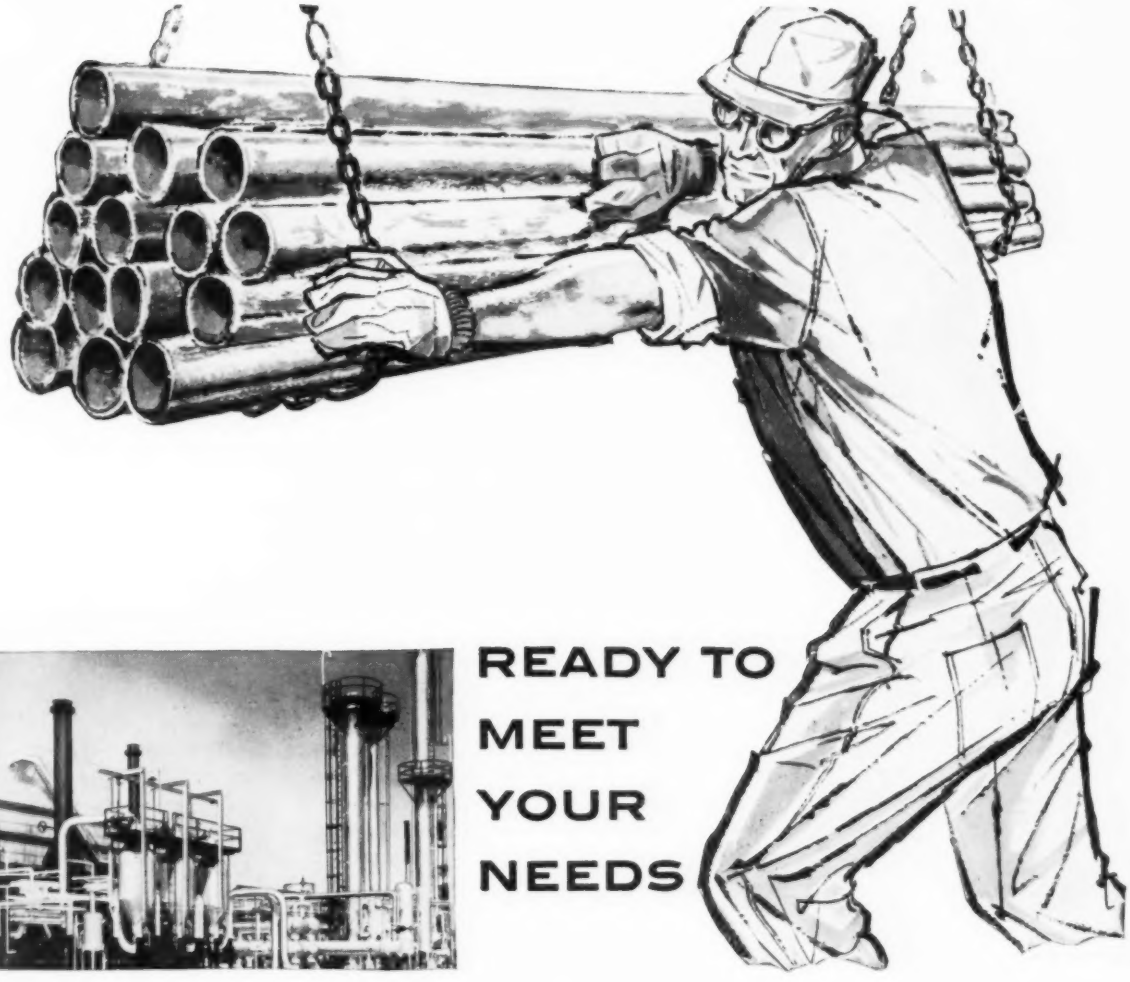
. . . **Kerr-McGee Oil Industries, Inc.** has acquired all the capital stock of the Cato Oil & Grease Co. of Oklahoma City, Okla. Cato will continue to operate as an individual company.

. . . **French Petroleum Co. of Canada Ltd.**, Calgary, Alta., is new, wholly-owned subsidiary of Francaise des Petroles formed to handle Francaise's properties and operations in Canada.

. . . **Hawthorn Corp.** has been formed for the joint Hercules-Imperial Chemical project (see PETROLEUM PROCESSING, Sept., 1956, p. 10) to manufacture 35-million lb/yr of methyl methacrylate at Louisiana, Mo. Ownership will be 50-50 between Hercules and Imperial.

. . . **Stanolind Oil and Gas Co.** has taken the new name of Pan American Petroleum Corp. The change was made as a part of parent company Indiana Standard's current reorganization among its affiliates.

. . . **American Petrofina** continued its U.S. expansion by buying American Liberty Oil Co. of Texas. The



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acquisition gave Petrofina a 16,000 b/d refinery at Mt. Pleasant, Texas. Identity of American Liberty will be retained.

In Foreign Operations

. . . Britain and Europe

A/S Norske Esso and the Norwegian government have reached an agreement in principle for a 40,000 b/d, $29-million refinery to be located on the Oslo Fjord. If the Norwegian Storting (parliament) approves, operation is planned for 1960.

BP Benzin & Petroleum GmbH (British Petroleum) plans an 85,000 b/d refinery (ultimate capacity to be 117,000 b/d) in the Rhine area, in Krefeld or Cologne. Emphasis will be on heating oil.

Deutsche Shell A.G. plans a new refinery with 60,000 b/d capacity (eventually 120-140,000 b/d) between Cologne and Bonn, W. Germany. **Other Shell plans** are for a 40,000 b/d expansion (to 56,000 b/d) of its Hamburg refinery (scheduled for 1958), and an enlargement of the polyethylene plant near Cologne jointly owned with Badische Anilin & Soda Fabriken.

Esso Standard Refinery, S.A. has awarded contract for $6,000,000 to Badger-Comprimo N.V.—newly-formed subsidiary of Badger Mfg. Co. and Camprimo, N.V. of Amsterdam—to build a 6900 b/sd Hydrofiner, a 5600 b/d Powerformer, and other facilities at Esso's Antwerp, Belgium, site with completion due early-'58.

Fisons Limited has awarded a contract to Chemical & Industrial International, Ltd. to build a 250 t/d nitric acid plant at Stanford-le-Hope on the Thames estuary, England.

Purfina Italiana (Petrofina) and Anic (ENI) will build a refinery on a 50-50 basis near Rome to replace existing plants in Rome.

Rheinische Olefinwerke will increase production of high-pressure polyethylene and styrene monomer at its Wesseling, Germany, plant from 10,000 t/yr to 30-35,000 t/yr by 1958. Cost will be $33.3-million.

Royal Dutch/Shell Group plans to "build or extend —by ourselves or in conjunction with others—refineries in Ireland, Germany, Turkey, Japan and possibly one or two other countries."

. . . Latin America

Celanese Mexicana, S.A., has started building a plant near Mexico City to make formaldehyde and synthetic resins derived from formaldehyde.

Creole Petroleum Corp.'s planned Hydrofiner will have a capacity of 14,500 b/d and will cost about $3-million. The lube plant will cost $6.3-million (see PETROLEUM PROCESSING, Dec., 1956, p. 12). Both are scheduled for 1958 at the Amuay Bay (Venezuela), refinery.

The Venezuelan Petrochemical Institute will ask for bids for a series of major projects for the national petrochemical industry at Moron. Projects include a dam, port facilities, additional petrochemical plants and a flood-control channel.

Industrias Químicas Electro Cloro, S.A. has received exclusive Brazilian rights to Phillips Petroleum Co.'s rigid polyethylene process.

National Bulk Carriers has begun work on the site for a new $33-million refinery near Colon, Panama, with completion in two years.

A second refinery is also being planned for Colon with an estimated $30-million investment involved.

. . . The East

Asahi Chemical Industry Co., Ltd. will build a Chemical Construction Co.-designed ammonia plant to make 50 metric t/d ammonia at Noboeka, Miyazaki-ken on Kyushu Island, Japan. The Texaco oil gasification process will be used.

The Ceylon Government has been approached by a group of Indian industrialists backed by French, Iranian and Greek interests to build a refinery in Ceylon. Previous offers to build a refinery in Ceylon have been refused (see PETROLEUM PROCESSING, Nov., 1956, p. 12).

Purfina (Petrofina) has government permission to build a 20,000 b/d refinery at Luanda, Portuguese West Africa.

A Turkish refinery, near Istanbul, is planned as a joint effort between Socony Mobil (37%), Caltex (34%), Shell (18%), and British Petroleum (11%). The 65,000 b/d refinery will cost about $48-million.

in Markets and Prices

. . . Humble touched things off January 3 with a hike of 25¢ to 45¢ in Texas crudes and the rumbling from it will continue for many months. The price situation was by no means clear in early February.

Some felt that the crude increase would stick, while others felt the hike would disappear in face of a resumption of crude movements through the Suez Canal.

. . . The increase in crude, though long-expected because of basic cost factors, hit domestic refiners at a bad time. Gasoline stocks were at an all-time high, and stood at 11.5% above a year ago.

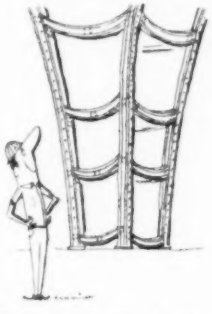
While heavy fuels were extremely tight (except around Chicago), light fuels at inland ports were having a bad time of it because of an unusually mild December. The fact that light fuels were tight at the Gulf merely complicated the whole relationship between crude and products.

By February the picture was brighter. A cold January cut deep into distillate stocks in the interior. Gulf-area refiners were saying that middle-of-the-barrel products would remain short through April. And for frosting on their cake, gasoline prices at the Gulf moved up 0.25¢/gal for most grades, effective January 23.

New "Plastic" Theory of Steel May Replace Elastic Design Idea

LOWER cost steel structures in the refinery are a strong near-future possibility now that designers have a new method of steel design.

The new "plastic" theory of steel design promises savings of 5-35% in steel costs, more efficient use of structural steel, faster and simpler design methods, and a more realistic and constant factor of safety.



Based on principles almost directly opposed to those of the long-accepted elastic theory of design, the new theory depends on localized permanent deformation of a structural member to form what is termed "plastic hinges" within the member. The old elastic theory is based on the yield point, or elastic limit, of the member, and no permanent deformation is allowed.

The new theory permits the designer to take advantage of the very appreciable ductile strength remaining in steel after the elastic limit has been reached.

To ease the job of engineers and designers accustomed to elastic design, the American Institute of Steel Construction will soon publish a design manual based on the new plastic theory. Until then, AISC is presenting a series of lecture conferences throughout the country to acquaint engineers with the new methods.

At one such conference at the University of Houston last December, E. R. Estes, AISC research engineer, and Dr. Bruno Thurliman, research associate professor at Lehigh University, explained the new theory to a gathering of some 200 engineers and designers from Gulf Coast industrial and engineering firms.

Here is their explanation: Permanent deformation of a load-carrying member is not as bad as it sounds: steel does not fail suddenly. The plastic hinge, or area of permanent deformation, is made possible by the ductility of steel, and is formed when the full structural usefulness of the member is reached. Therefore, the basis of plastic design is the true load-carrying capacity of the entire cross-section of the member, rather than the yield point of the outermost fiber, as in elastic design.

Plastic design methods are simpler, and calculations, especially, are easier when figuring redundant members. In addition, plastic theory can better predict the ultimate load of a structural member.

Deflection, though small, is greater when permanent deformation occurs, and might be a limiting factor. Also, the theory has been applied only to simple, single-story structures, although the principles are being extended to complex, multi-story structures.

Engineers face a new terminology of steel construction and have good reason to expect some old terms to become irrelevant. Structural engineers have long known that present design methods are over-cautious and steel-wasting. There is little doubt that they will welcome the new theory and will soon become its most ardent proponents.

—R.E.C.

Ultrasonics Seen as a New Aid to the Maintenance Men

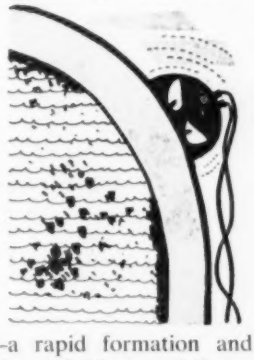
REFINERY maintenance men may soon have a new tool permitting "in place" cleaning of refinery equipment without excessive dismantling.

Ultrasonic cleaning—cleaning with high-frequency vibrations—is now used commercially for cleaning small parts. Development work is in progress on more powerful equipment for larger applications. Small units are now under test in some refinery applications.

Preliminary reports of results with small units indicate that ultrasonics: 1) cleans more thoroughly and faster, 2) reduces number of cleaning stages, 3) requires lower solvent temperatures, 4) removes many deposits now thought insoluble, 5) increases effectiveness of chemical cleaning, and 6) uses less corrosive cleaning chemicals.

Branson Instruments, Stamford, Conn., McKenna Laboratories, Santa Monica, Cal., Gulton Industries, and Acoustica Associates are actively developing equipment for the new technique. Several major refiners, as well as suppliers of cleaning chemicals, are reported investigating possibilities of ultrasonics.

Ultrasonic cleaning involves activation of a cleaning solvent by high-frequency energy in the form of mechanical vibrations. These vibrations literally "shake" deposits off.



Basic components in present equipment are a generator and a transducer. The electronic generator supplies high-frequency electrical energy which the transducer converts into high-frequency mechanical vibrations. These vibrations create cavitations—a rapid formation and collapse of bubbles within a fluid, especially at fluid-metal interfaces—in the cleaning solvent or

chemical, providing an erosive action equivalent to scrubbing.

In practice, an exchanger might be removed from service, filled with a suitable solvent, and cleaned by the combined actions of chemicals and mechanical vibrations without dismantling. After flushing, the exchanger would be returned to service.

Lines, too, could be cleaned without dismantling. Collars, or clamps, would be used to attach the transducers, or vibrating elements to the pipe. For easily soluble deposits, lines and equipment might be cleaned while in service if provisions are made to trap out and remove deposits once they are broken off the walls of a vessel or pipe.

Ultrasonic cleaning equipment can now be bought in small sizes. However, equipment for refinery use is still in the future, because of heavy deposits and the larger sizes needed. Biggest present hurdles are: large power requirements, size of generating equipment, and high cost.

If present developmental work can clear these obstacles, you can look for ultrasonic cleaning as a big step to shorter turnarounds, longer on-stream times, and lower maintenance costs. —R.E.C.

Radiation's Future in Petroleum Needs a Strong Safety Program

EXPANDING use of radioactive tracers and other radiation sources in the petroleum industry means a new type of safety program may be on the way.

Actually, the principles of radiation protection are already well known, thanks to years of groundwork by the Atomic Energy Commission. The real problem is to adapt these safety principles to specific applications within the petroleum industry.

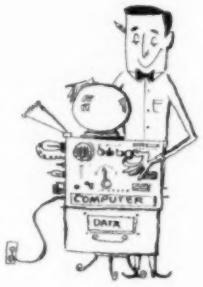
Radiation hazards are not as obvious as conventional refinery safety problems. Radiation can neither be felt, smelled, nor seen. However, with the basis of a good safety program conducted by a qualified Health Physicist, the petroleum industry can expand its use of radiation sources safely.

Industry will learn that radiation safety responsibilities cannot be dumped on an unprepared safety man. A qualified "Health Physics" expert will be the logical person to design and safely conduct radiation work. Also, there will be the problem of on-the-job training of other personnel.

The results of these early lessons will probably lead to a radiation safety sections entirely separate from conventional safety sections, and directly responsible to top management. In this way, the petroleum industry can assure a safety record that will prevent public "hysteria." —R.L.D.

Science Will Help Us Do More Than Just Talk About Weather

BETTER long-range weather forecasting is definitely on the way. Accuracy may reach 70% in the next 20 years, in comparison to much less than 50% today.



Seasonal forecasting of temperatures in given geographical areas with accuracies of this caliber will provide great benefits to the petroleum processor. One big reason is that distillate fuel oil sales have grown so that they are now the largest single volume product next to gasoline. These products are now being supplied at the rate of 1.6 million b/d average. Their principal use is for residential and building heating. Demand varies with the season—from about 2.45 million b/d in midwinter to 0.9 million b/d in some summer months.

Advance knowledge—from long-range weather forecasts—of the likely changes in requirements during any future heating season would enable refiners to plan better operating and inventory schedules.

The American Petroleum Institute has an Advisory Committee on Fundamental Research in Weather Forecasting whose studies have already provided some firm ideas of future expectations. At the recent annual API meeting in Chicago, this committee sponsored a session on weather forecasting—comprising technical papers by various meteorological authorities.

The improvement in accuracy from 50 to 70% was predicted by Hurd C. Willett, professor of meteorology, Massachusetts Institute of Technology, who gave three reasons for his optimism:

1—Basic research in this field has been greatly extended since World War II.

2—Since that war, observational data has become available on a hemisphere-wide scale.

3—The use of high-speed computing facilities available today makes practical the analysis of observed data in ways not possible when hand computations are required.

Besides processing, other petroleum activities will benefit from long-range weather forecasting: oil field exploration and production, pipelines, marine activities, and the like. To paraphrase the old saw—somebody is doing something about the weather, not just talking about it. —V.B.G.

Petroleum Processing

LETTERS

Octane Depreciation

To THE EDITOR: Would you be able to find space in your magazine to make a correction that concerns me? I refer to a statement by Dr. Rippie on p. 88 of your October, 1956, issue (Treating and Other Problems," pp. 87-90):

". . . You will find . . . a most alarming depreciation of octane by 1.2 peroxide numbers . . . a loss of about 10 research octane by 1 peroxide number . . ."

Dr. Rippie refers to my paper "Antiknock Antagonists," in *Industrial and Engineering Chemistry*, March, 1951, pp. 663-671, in which the pro-knock activity of peroxides is discussed. In particular he refers to data from my Table X, which shows a loss of about 10 research octane numbers (9.8 units to be exact) on the addition of peroxide to a leaded reference fuel.

This loss occurred on addition of 2.82 grams of tertiary butyl hydroperoxide to one kilogram of reference fuel, which corresponds to 0.10% peroxide oxygen added to the gasoline on a weight basis. Dr. Rippie quotes this as being an increase of *one* in peroxide number. Actually, it is equivalent to a peroxide number of approximately 90, and, therefore, is far in excess of any concentration that is encountered in gasoline under practical conditions. I would predict that the effect of an increase in peroxide number of *one* would be too small to measure accurately under the conditions of my experiments.

It is unfortunate that I used the unfamiliar expression "percent oxygen" in my paper, and I regret that this has confused Dr. Rippie, and possibly others. The reason is implicit in the purpose of my paper, which was to compare compounds of seven different elements for their effect on antiknocks. Comparisons were made at 0.10 wt-% of the antagonistic element, and the addition of 0.10% peroxide oxygen was a part of this overall testing program.

H. K. LIVINGSTON
Asst. Director,
Research Division
Electrochemicals Dept.
E. I. du Pont de Nemours & Co.
Wilmington 98, Del.

• *Thank you, Reader Livingston for bringing this fact to the attention of our readers.*

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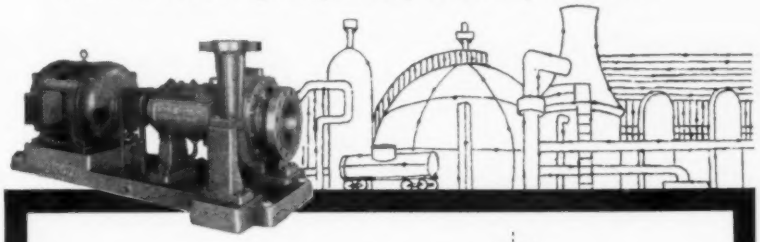

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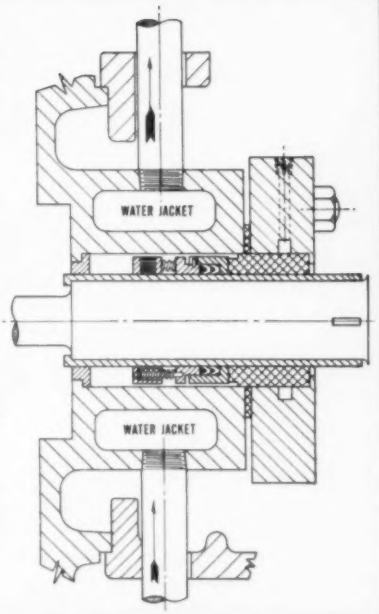

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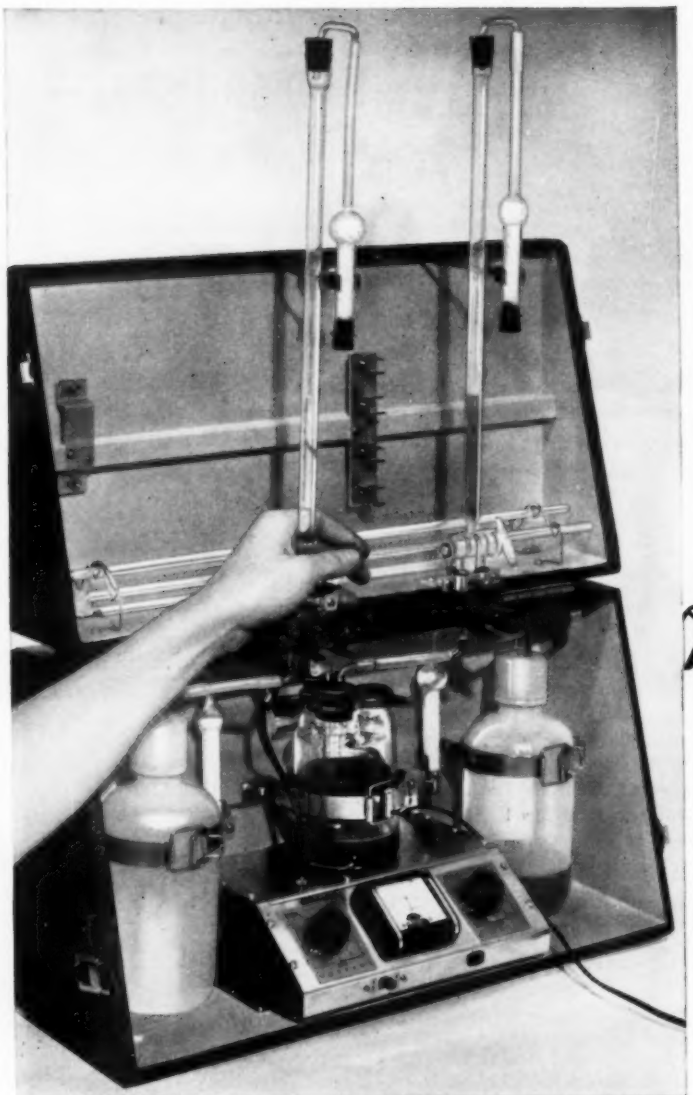

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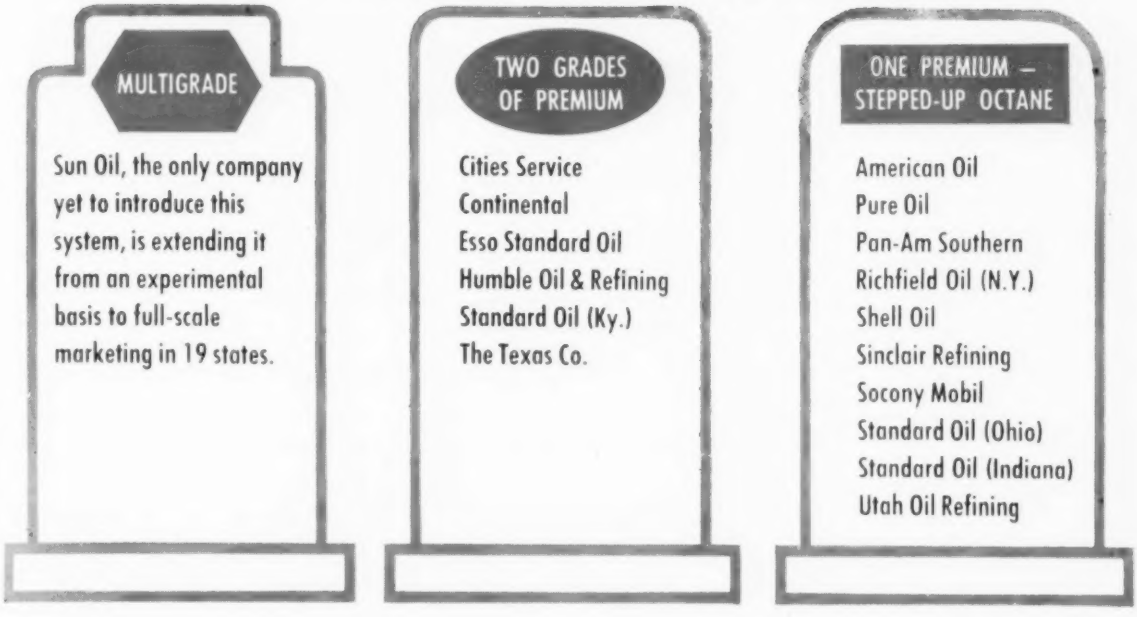
Petroleum Processing
February, 1957

Today's Lineup on Premium Grade Gasoline



100+ Octane after One Year

What has happened in this year? What does the industry see for the future?

By V. B. GUTHRIE, Associate Editor

TODAY, this much is certain. The new 100-plus octane premium motor gasolines have definitely "caught on" with the oil companies, the motoring public, and the automotive industry.

Tangible evidence of the wide adoption of "super" premium marketing programs by oil companies is the fact that these fuels are now being sold by 17 large oil companies in a gradually expanding territory soon to include most of the nation except the West Coast. (See table above.)

Public approval is shown in reports from several oil companies that sales of all premium fuels have increased about 10% wherever the new gasolines have been introduced. The companies won't speculate on how much of this increase can be held, because they recognize that some of it must be attributed to the extensive promotion campaigns for the new fuels. However, unsolicited testimonial letters from users do indicate public approval.

Detroit likes them too. Evidence of approval by the automotive industry is shown in the increase in compression ratios in the 1957 model cars. The average increase is from 8.45:1 in 1956 to 9.14:1 this year, and more of the new cars will be in the premium fuel bracket now that super premium gasolines are becoming generally available, PETROLEUM PROCESSING's automotive editor reports from Detroit.

The marketing pattern for the new fuels is not yet firmly established, but three methods are now in use at service stations:

1—The multigrade dispensing pump system introduced by Sun Oil Co. last February as an experiment is today no longer regarded as an experiment by Sun. The company has announced it will extend the sale of five grades of gasoline through its single blending pump throughout its entire 19-state marketing territory.

Installation of the new pumps is expected to be completed by the middle of 1958. Sun will make an "important interim move" this spring by introducing a super premium grade as a companion product to its present "Blue Sunoco." The new premium will be the same as one of the blends available from its five-grade system now being offered in the South.

No other company besides Sun has yet adopted a multigrade premium scheme. Some other oil company refinery managers say privately they believe that this, or some other similar means for offer-

ing the motorist a choice of several grades of premium fuels, provides the refiner with the best method to increase equitably his realization on pool gasoline.

2—The premium grades. Six oil companies are now selling a "super" grade separately from their established premium grade. Four of these—Esso Standard Oil Co., Standard Oil Co. (Kentucky), Humble Oil & Refining Co., and Cities Service Oil Co.—introduced their new products in certain areas last fall, and are now extending distribution throughout their marketing territories. Another, Continental Oil Co., considers its program still in the experimental stage. The Texas Co., a newcomer, announced recently it would market an upgraded premium fuel at 1¢/gal above the price of its established premium. It will sell the new product first in its East and Gulf Coast territories.

3—Single grade with stepped up octane. Ten oil companies are continuing to sell one premium grade of gasoline but have announced publicly that the octane value would be raised to meet the competition of the new super premiums. The combined marketing territories of these companies blanket the country, but no super grade marketing programs have been announced yet for the Pacific Coast.

Besides these 17 major oil firms, six others are still not committed to a new program. They include Atlantic Refining Co., Gulf Oil Corp., Phillips Petroleum Co., Standard Oil Co. (California), Tidewater Oil Co., and Union Oil Co. of California.

PETROLEUM PROCESSING'S Detroit automotive editor believes that within a year or so fuel injection may become a factor in compression ratio increases. Chances are that many new models will offer fuel injection options to new car buyers in 1958.

Automotive engineers differ on how fuel injection systems will affect gasoline octane requirements. Some believe it permits a cushion of about 5 on engine octane requirements. This means that fuel injection would make it possible to increase the engine requirement another 5 octanes and still obtain satisfactory performance with present premium fuels. Other engineers concede a possible gain but doubt it will be as much as 5.

The Near Future—As Refiners See It

These four developments will shape up the super grade gasoline marketing picture in the coming months, in the opinion of refinery managers of the larger oil companies:

1—The long range trend will be to market two grades. As octane requirements continue to rise, refiners believe it will be less costly in general to make a limited volume of super premium and install tanks and pumps at service stations to handle a second grade rather than to step up the octane of all their premium fuel to meet top octane needs of the new model cars.

2—The price of the supers will level off at 5 to 6¢ above regular grade. A differential of at least this range will be needed to compensate the refiner for the added cost of making the higher octane products. Competition will hold the price of present premiums to 3¢ above regular grades in most areas, although manufacturing costs would justify a larger differential.

3—The use of additives will be stimulated in the new fuels. These materials promote engine cleanliness and thereby hold down the octane requirements of the new cars. They will not, however, eliminate the need for progressively higher anti-knock fuels. Pre-ignition will become a more important problem when compression ratios reach 10 or 10.5:1, and the solution may be found in some feature of the fuel other than additives.

4—Regular grade gasolines cannot be neglected in today's octane race; however, their octane values are not expected to increase at the same rate as those of the premium fuels. The spread between top premium and regular is expected to reach 10 octanes in place of the present 7 or 8. Economy buying may force more motorists within the next few years to turn to regular grade and these buyers will want a fuel that can give them satisfactory performance.

These conclusions represent the consensus of opinion of refinery managers of the large oil companies. These men were queried by the Editors of PETROLEUM PROCESSING after the new high octane super premium gasolines were introduced generally last fall. Their replies cover refining and marketing practices in all areas of the country, including the West Coast.

Following is a summary of these comments, which were made in the form of replies to four questions posed by the Editors:

What Refiners

Will the price differentials of the new premiums over regular grade reach a level that will compensate refiners for their added cost of manufacture?

An East Coast refiner: "Service station prices for the various grades of premium gasoline in our area appear to be settling down into a pattern. The 97-octane premiums have reached a price differential of 3¢, the so-called super premiums in the 98-99 range have jumped to 4¢, and the 100-plus fuels have been introduced in the 5-6¢ range. Competitive pressures and public acceptance may well stabilize the price spread at about these levels."

A Minnesota refiner: "Subject to finding that the cost of making the new gasolines is higher than had been anticipated, we believe the service station differential between regular and top premium should be 5¢, and that between regular and ordinary premium 2-2.5¢."

A southwestern oil company: "Competition will determine the station price levels, but, viewed from a cost angle, it appears that premium grade fuels in the 100-plus octane range should sell for at least 5.5¢ above regular."

A California company: "The service station price differential should represent the cost of the higher octane premium grade. However, in this section of the country, competitive pricing structures may be more important in determining this price differential than any refiner's cost."

A mid-continent refiner: "We believe the first premiums that have been introduced are on the low price side. For a special grade for the new model high compression cars there will have to be a considerable price spread over regular if we are to recoup the higher refining and marketing costs."

An Ohio refiner: "Raising the octane level is not the only characteristic required for the new improved premium fuels. Problems with respect to vapor pressure and distillation properties may also be involved. Pre-ignition presents an important problem when the compression ratios reach 10 or 10.5:1; new solutions may be forthcoming here."

A Texas oil company: "An octane number rise from 100 to 101 in premium grade, with a concurrent rise of one number in housebrand, would cost in the neighborhood of 0.5¢/gal

Are Thinking about the Super Premium Gasolines

for the entire pool, not including investment or amortization of equipment."

A Pacific Coast refiner: "It is practical to produce gasolines in the 100 octane range by catalytic reforming, solvent refining, and isomerization. The cost depends on several factors affecting each individual refiner."

Will the trend be to sell one or more grades of premium gasoline to make sure that the new higher compression cars are supplied with a satisfactory fuel?

A Sun Oil spokesman: "Economically and technologically, the ideal marketing system would be one that distributed to the total car population along its octane requirement distribution curve. The refiner, then would be making the minimum number of octane-barrels. The public in turn would be getting complete anti-knock satisfaction and would be paying only for the quality needed. The fact that we are experimenting with a 'Custom Blending' system indicates how we feel on this question."

A southwestern refiner: "Two or more grades of premium may not be the ultimate answer. The chief immediate problem is economic; i.e., how can their higher cost be recovered. It may be that a plurality of premium grades will serve the necessary end of equitably increasing refinery realization for pool gasoline."

An East Coast refiner: "The trend will be in the direction of two grades of premium, providing the national economy remains high and luxury money is plentiful. The super premium is for those who want the best, for the cars equipped with extra power packages. Because there is no gain in economy with these fuels, the demand for super premium will depend on luxury money."

A Gulf Coast company: "From a manufacturer's standpoint, supplying more than two grades would be sound, but it is offset by the expense of installing additional marketing facilities. Most of the industry in this area has decided to retain two grades, believing automobile requirements can be satisfied properly."

A midwest firm: "If present design trends continue, gasoline manufacturing costs can be decreased by selling two grades of premium fuels. It appears that most companies will be offering two grades within two or three years."

A West Coast refinery: "We believe and hope the trend on the Pacific Coast will be to sell only one grade of premium and one of regular gasoline. It appears to us the trend in car design is such that almost all the new cars will require 98 to 100 octane, while the older ones can take an 86-90 regular grade.

An inland oil company: "We believe that after a year or so the trend will be to sell one grade of premium, rather than two. The present distributors of two grades will find that all they have done is to take a sizeable quantity of product away from their middle grade and that it will not be worthwhile to continue to handle this middle grade throughout their entire distribution system."

With octane values for premium fuels trending sharply higher, what will happen to regular grade?

A mid-continent refiner: "We believe that in the eastern, central, and southern sections of the country the spread in octane number between regular and premium will become 10 or 11 rather than the 7 to 8 differential that exists now. In other qualities, the regular grades of the next seven or eight years will have to be at least as good as today's gasolines, because in many cases today's cars will be using what will then be known as regular gasoline."

A southwestern company: "The quality of regular gasoline will continue to rise as fast as that of premium during the next few years, although there will be little technical justification for this. Regular gasoline is not only the refiners' bread and butter product, but it is also the product for the bread and butter customers, who will be the deciding factor in all these questions."

A West Coast company: "We anticipate that octane numbers for regular gasolines will go up as premium octanes increase, but other qualities of regular are not likely to see much change. We do not see much future for regular except to supply the older cars on the road until the automobile manufacturers begin to stress fuel economy."

A Texas refiner: "With only moderate increases in octane number, regular grades should continue to satisfy the bulk of the total car population for several years. Many companies are likely to improve other fuel qualities such as volatility, gum and deposit formation. Regular grade advertising may feature these aspects with a decreased emphasis on octane."

A midwest refiner: "We think we will find regular grade moving up in octane values as the requirements of the lower price cars dictate. We anticipate a 3-octane number increase in these grades in the next year and a half."

Will it become as important to use an additive to promote engine cleanliness and hold down octane requirements of cars already on the road as to raise octane values of the fuel?

A Gulf Coast company: "It is extremely important to consider cleanliness in high compression engines, which are more susceptible and sensitive to deposits. Cleanliness can become an important factor in performance and octane requirement. Refining approaches to this end may differ, but we expect the use of additives and improved tetraethyl lead scavengers to receive greater emphasis."

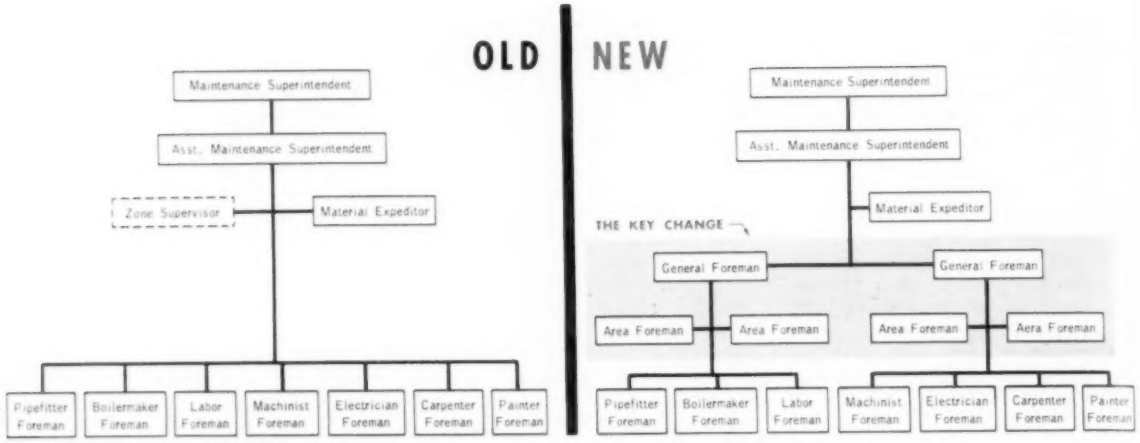
A Pennsylvania refiner: "Combustion chamber cleanliness will be a very important factor in the operation of the new model high compression engines. Research will continue to improve both fuels and oils with additives. These improvements will not, however, eliminate the need for higher-octane-number fuels."

An East Coast refiner: "It will be important for competitive reasons for individual refiners to insure that their products do not give dirtier engines. From an industry standpoint, the problem is not as important because cleaner engines will lead to higher compression ratios, which should give improved economy. However, the gain above 11 or 12:1 is small."

An Oklahoma company: "We do not consider that crossing the 100 octane barrier suddenly changes the engine cleanliness problem. We anticipate that many features of motor fuel and engine performance other than anti-knock will receive technical and advertising attention in the future."

A Texas company: "We see little hope that fuel additives will be as beneficial to the engine as will octane values."

THIS MONTH'S M&C PANEL FEATURE



CREATING AREA FOREMEN gave Celanese tremendous results, that's why they say . . .

For More Effective Maintenance

Adopt an Area Foreman Plan

By HERSCHEL V. WILKS, Manager—Engineering & Maintenance
Celanese Corp. of America, Bishop, Texas

CHANGING our maintenance set-up to include maintenance area foremen has given us two big benefits: improved planning and better supervision of maintenance. The production supervisor now has someone to share his burden, and unit efficiency has risen. Total result: more than a 50% increase in planning efficiency.

To show how area foremen contribute to maintenance and production departments and how they may improve service, we'll use our own chemical plant experience. We employ about 750 people, including about 300 in the maintenance department.

The Old System

When our plant was first put into operation, there was a period between construction and plant operation during which the construction forces remaining at the plant were used to help maintain equipment. This procedure is generally used by most companies until they can establish their own organization to perform the maintenance functions.

As most chemical plants are readied for operation, there are many adjustments, alterations, and changes necessary before this transition period is overcome and stabilized production schedules arranged. During this time, many different needs arise involving different types of know-how.

Our first people employed in the maintenance phase were basically machinists with a general knowledge of all functions of the crafts. These people could not take care of everything, so construction personnel served most of our needs for several months. Meantime, the mechanical department continued to expand and all craftsmen were classified as mechanics.

After a few months, our plant was in full operation and the need for specialized personnel increased to where craft lines and craft supervision became a part of our organization. At this time about 300 people were employed in the maintenance department doing maintenance and light construction work.

Shortly after the transition from general craft to separate crafts, it became apparent that better coordination of craft work was necessary.

The chart shows the type of organization used up to this time. To meet the need for greater coordination, the position of zone supervisor was created in 1951, functioning with modifications until 1954 when the new system was set up.

Functions of zone supervisors as set up under this system were:

1—To direct safely and economically, in their respective zones, the services of the mechanical department for maintenance, replacement, and repair of all processing equipment such as machinery, tanks, buildings, instruments, roads, etc.

2—To maintain the equipment essential to processing operation in the best state of repair consistent with operating schedules and established standards.

3—To direct the construction and installation of new facilities in accordance with established standards of design, workmanship, and costs.

4—To maintain good general appearance of equipment, roads, drainage, buildings, etc., in each respective zone.

The zone supervisors under this system coordinated all mechanical work under the assistant mechanical superintendent, through the craft foremen, and reported directly to the assistant mechanical superintendent. The zone supervisors had no line authority over craft people. They served in a coordinating capacity.

The prime objective, of course, for creating this position was to better the overall job planning, scheduling, and coordination between the mechanical and production departments.

This new arrangement accomplished its purpose at the time, but as our plant expanded and our experience increased, we felt that other changes were necessary to further increase our maintenance craft efficiencies and provide a better service to the production people.

The New System

Although it was our policy to insist on a close relationship between the maintenance man and the production man, we felt that to reach this objective and give better service we had to get the maintenance supervisor and his people in position to give even quicker and more constant service.

The two zone supervisors were no longer able to give sufficient attention to the details to provide the best service possible. As the work increased, the time the production supervisor spent on maintenance problems increased. This was to his disadvantage because production difficulties were also increasing. We needed some method to relieve him of most maintenance problems.

Before making any more organizational changes, a thorough study was made of the exact needs and end results that should be accomplished. These important points were used as objectives: improve efficiencies, give better service, and reduce costs.

To reach these goals, a broad form of area maintenance was installed. Two general foremen were appointed, each responsible for the maintenance activities in half of the plant.

The plant was divided into four areas and an area foreman was assigned to each one, with two reporting to each general foreman. Each general foreman also assumed line authority over crafts, with all craft foremen reporting to the general foreman.

There were about 300 people attached to the maintenance department at this time. The general foremen were no longer coordinators, as were the zone supervisors, but their responsibilities were broader: they established work priorities among the foremen and trained foremen to work together to get the job done. The chart shows our maintenance organization and the area foreman relationship to other supervision.

Each area foreman is responsible for the work performed in his area. His headquarters are in the area he serves and he spends over 80% of his time in his area. His office and that of the area production supervisor are located as nearly together as possible.

The size of the areas covered by zone supervisors was reduced so the area man could give more attention to supervision and detailed planning in his area.

Not only does he plan and coordinate the work of crafts in his area, but he regularly and directly supervises people in as many as 6 to 10 crafts-people assigned to his area at his request to do emergency and routine work. He has jurisdiction over these people during the time they are assigned to him. These men, of course, are assigned temporarily on a day-to-day basis and are returned to their craft foremen when no longer needed in the work area.

Although the area foreman has no line authority over craft foremen, he may exercise the right to constructively criticize the poor workmanship of any craft man in his area and demand that it be corrected or improved.

Advantages of Area Maintenance

Because the area foreman is constantly and permanently in the production area and has maintenance people available for his needs, we immediately accomplish two objectives—

1—The area foreman and production supervisor now share the same field office. Communications are excellent and most mutual problems are worked out as soon as they arise.

2—Labor to take care of "running" or routine maintenance as well as emergencies is now available in the field, saving traveling time from central shops. Also, less red tape is needed to get labor for a job. The area foreman is responsible for ordering and expediting material for these jobs and have it available for the craftsman.

For emergency jobs, or jobs larger than "run of the mill," the foreman usually takes charge of his particular craft people to make the repairs. However, if the foreman is out of the area, the area foreman assumes direct authority over the workers and makes the decisions.

The success of this procedure, of course, depends upon the close working relationship of the area foreman, the craft foreman, and the crafts people. We have excellent relationships between these people, which is the reason for our success.

The production supervisor, under this type of operation, now has to make requests of only one person, the area foreman, to perform any maintenance service with the assurance that a job requiring a number of different crafts will be completed as requested or scheduled with a minimum of effort on his part. This is a contrast from the previous method used before the area foreman's position was created.

In the past, it was necessary for the production supervisor to make direct contacts with the various craftsmen to check on job progress or to expedite work being done.

Under this old set-up we estimated that the production man spent as much as 50% of his time directly or indirectly with his unit maintenance problems. This took much of his valuable time away from his production problems. Now he spends about 15% of his time, approximately on maintenance problems and gets much better results from the men maintaining his equipment.

After all, the production man's basic responsibility is to operate his unit at maximum efficiency. Under this type of service he is relieved of the details of seeing that a maintenance job is properly executed.

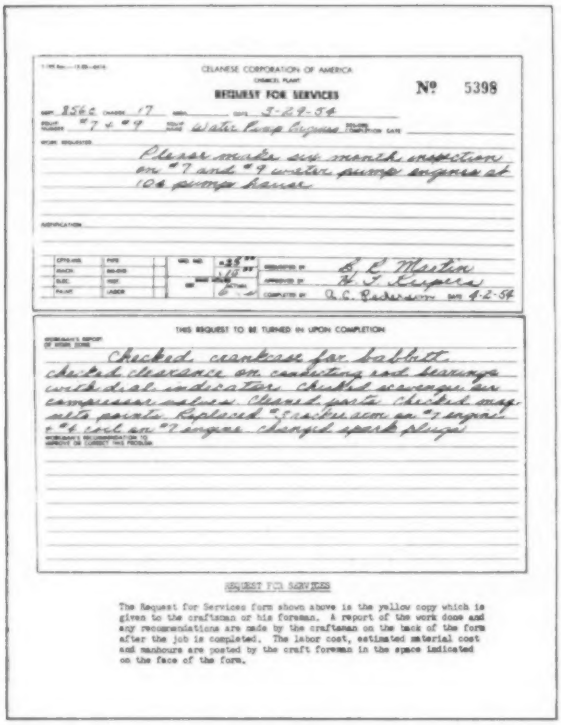
The efficiency of the maintenance

Bonuses from Area Maintenance

Adopting the area foreman program has upped daily planning effectiveness for Celanese 50%, giving a current effectiveness of 90%. Weekly planning effectiveness has been more than doubled, up from 30% to 75%.

Because of better planning, supervision of craft people, close coordination of men and materials, Celanese's Bishop plant produces constantly above its rated capacity with a maintenance cost of only about 5% per year of capital investment.

These are the forms we use for our maintenance system



CELANESE CORPORATION OF AMERICA

REQUEST FOR SERVICES

Nº 5398

3-29-54

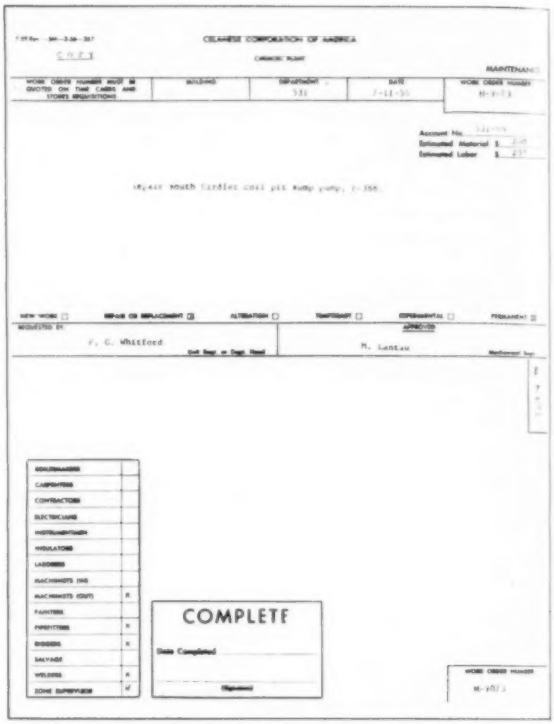
Please make six month inspection on #7 and #9 water pump engines at 104 pump house.

THIS REQUEST TO BE TURNED IN UPON COMPLETION

Checked crankcase for babbitt. checked clearance on conducting rod bearings with dial indicator. Checked acreage on compressor valves. Cleaned parts. Checked mag. with points. Replaced #7 rocker arm on #7 engine. Put on #7 engine changed spark plugs

The Request for Services form shown above is the yellow copy which is given to the craftsman or his foreman. A report of the work done and any recommendations are made by the craftsman on the back of the form after the job is completed. The labor cost, estimated material cost and manhours are posted by the craft foreman in the space indicated on the face of the form.

Fig. 1—**REQUEST FOR SERVICES,** used by production superintendent for maintenance costing under $50



CELANESE CORPORATION OF AMERICA

COMPLETE

Fig. 2—**MAINTENANCE WORK ORDER** used for work estimated to cost more than $50

department as now organized has increased greatly over that of the previous procedure.

Before adopting the area foreman program, our daily planning effectiveness was about 60% and is now 90%. Our weekly planning effectiveness was 30% before and is now 75%. These figures show a tremendous advantage to the operator on his planning and scheduling of production in his unit.

Executing a Job Request

The procedure of execution of a job request is as follows:

For maintenance jobs limited to a cost of $50, the production superintendent presents a written "Mechanical Request" (Fig. 1) to the area foreman, specifying priority. If it is an emergency job, to be performed that day, the area foreman immediately determines the approximate scope and arranges, through the materials expediter, for material to be delivered to the job site. He then assigns manpower.

If the job requires more manpower than his assigned men can handle, he requests additional aid from the general foreman in charge of the craft involved. The four area foremen receive and process a total of about 1,700 of these mechanical requests each month. The average cost of each request is $25.

If over $50 is estimated for the job, he requests a maintenance work order number by phone, through the assistant mechanical superintendent, stating the estimated cost and nature of the job. Allocation of the work order number is authorization to proceed with the work. A maintenance work order form is shown in Fig. 2.

If the request is an alteration in the equipment instead of a "replacement in kind," the area foreman routes the request through the maintenance engineering department for authority and specifications to proceed. An engineering expense work order (Fig. 3) is then issued by that department.

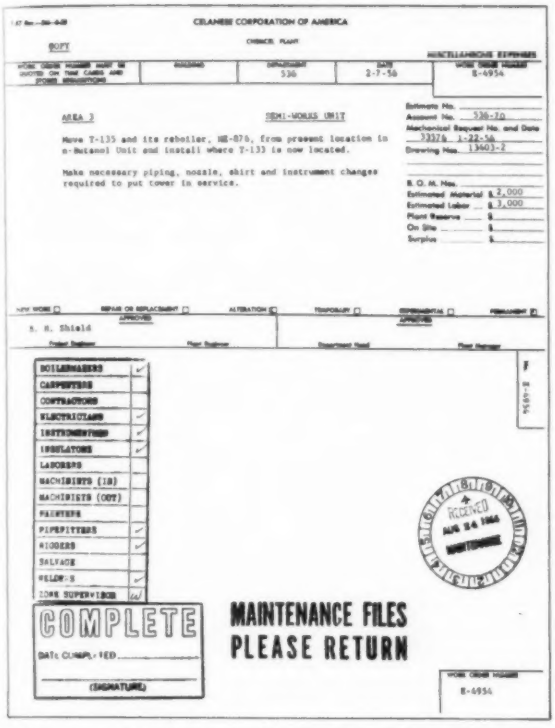
If the job is an emergency, authority is given verbally with a work order number and specification to proceed immediately.

Most jobs estimated to cost more than $100 are planned and scheduled. The area foreman figures prominently in the planned work schedule of his area.

Approximately 87% of all work performed by the maintenance department is now planned and scheduled well ahead of job execution. We attribute a large part of this success to the better preventive maintenance program now in effect under this new area maintenance procedure.

Each week a meeting is held between the production supervision and maintenance foreman, and work planned for the following week is discussed, scheduled, and given its appropriate priority.

The next day, the maintenance people, including assistant maintenance superintendent, general foreman, foreman, and area foreman, meet and discuss the work in detail. In doing this,



CELANESE CORPORATION OF AMERICA

CHEMICAL PLANT

MISCELLANEOUS EXPENSES

		DEPARTMENT	DATE	WORK ORDER NUMBER
		530	2-7-56	E-4954

AREA 3 — SEMI-WORKS UNIT

Move T-135 and its reboiler, HE-870, from present location in n-Butanol Unit and install where T-133 is now located.

Make necessary piping, nozzle, shirt and instrument changes required to put tower in service.

Estimate No.
Account No. 530-70
Mechanical Request No. and Date 33376 1-22-56
Drawing Nos. 13603-2
B. O. M. Nos.
Estimated Material $ 2,000
Estimated Labor $ 3,000
Plant Reserve $
On Site $
Surplus $

NEW WORK ☐ REPAIR OR REPLACEMENT ☐ ALTERATION ☐ TEMPORARY ☐ EXPERIMENTAL ☐ REARRANGEMENT ☑

APPROVED: S. H. Shield — Project Engineer

APPROVED: Plant Engineer

APPROVED: Department Head

APPROVED: Plant Manager

BOILERMAKERS	
CARPENTERS	
CONTRACTORS	
ELECTRICIANS	✓
INSTRUMENTMEN	✓
INSULATORS	
LABORERS	
MACHINISTS (IN)	
MACHINISTS (OUT)	
PAINTERS	
PIPEFITTERS	✓
RIGGERS	✓
SALVAGE	
WELDERS	✓
ZONE SUPERVISOR	✓

F E-4954

RECEIVED AUG 24 1956 MAINTENANCE

COMPLETE

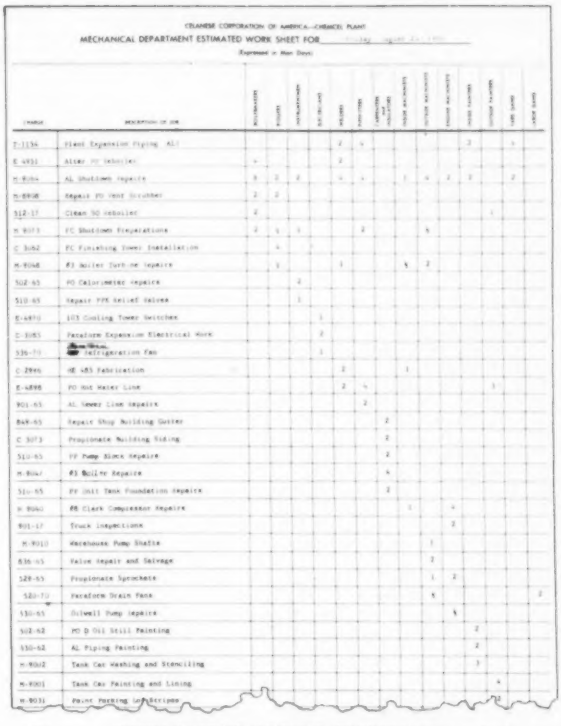
DATE COMPLETED

(SIGNATURE)

MAINTENANCE FILES
PLEASE RETURN

WORK ORDER NUMBER E-4954

Fig. 3—**ENGINEERING EXPENSE WORK ORDER** issued by maintenance engineering to alter equipment



CELANESE CORPORATION OF AMERICA—CHEMICAL PLANT

MECHANICAL DEPARTMENT ESTIMATED WORK SHEET FOR

Expressed in Man Days:

CHARGE	DESCRIPTION OF JOB	BOILERMAKERS	RIGGERS	INSTRUMENTMEN	ELECTRICIANS	WELDERS	PIPEFITTERS	CARPENTERS (SCAFFOLDS)	PAINTERS	INSULATORS	MACHINISTS (IN SHOP)	MACHINISTS (OUTSIDE)	SHEET METALMEN	LABORERS (GANG)	LABORERS (SAND)
T-1134	Plant Expansion Piping - All					2	4						2		4
E-4931	Alter FC Reboiler	4				2									
M-8364	AL Shutdown Repairs	8	2	2		4	4			1	4	2	2		2
M-8808	Repair FC Vent Scrubber	2	2												
512-57	Clean SO reboiler	4												4	
M-8373	FC Shutdown Preparations	2	4	2		2				4					
C 3162	FC Finishing Tower Installation		4												
M-8048	#3 Boiler Turbine Repairs		1			1				4	2				
502-55	FO Calorimeter Repairs			2											
510-55	Repair FPE Relief Valves			4											
E-4870	103 Cooling Tower Switches				1										
C 3085	Paraform Expansion Electrical Work				2										
536-55	Refrigeration Fan				1										
C 2946	HE 483 Fabrication					2				1					
E-4898	FO Hot Water Line				2	4							1		
901-55	AL Sewer Line Repairs					2									
849-55	Repair Shop Building Gutter							2							
C 3073	Propionate Building Siding							2							
510-55	FF Pump Block Repairs							2							
M-8047	#1 Boiler Repairs							4							
511-55	FF Unit Tank Foundation Repairs							2							
M-8060	#8 Clark Compressor Repairs									1		4			
901-57	Truck Inspections											2			
M-9010	Warehouse Pump Shafts										1				
536-55	Valve Repair and Salvage										2				
528-55	Propionate Sprockets										1	2			
520-70	Paraform Drain Pans										4				2
530-55	Oilwell Pump Repairs											4			
502-62	FO D Oil Still Painting												2		
530-62	AL Piping Painting												2		
M-8062	Tank Car Washing and Stenciling												1		
M-8001	Tank Car Painting and Lining													4	
M-8031	Paint Packing Lubricators													12	

Fig. 4—**ESTIMATED WORK SHEET** issued daily to schedule men for specific jobs on following day

each person knows what work is going to be done when, making scheduling easier.

Then, each day at 3:00 P.M., a sheet is filled out (see Estimated Work Sheet—Fig. 4) allocating and scheduling people to specific jobs for the following day. Each man is accounted for in this allocation sheet (the sample shown here is not necessarily correct).

Profit from Planned Maintenance

With the planning, supervision of craft people, close coordination of men and materials, combined and coordinated effort between production and maintenance people, it has been possible to maintain a chemical plant better, allowing it to produce constantly above its rated capacity at a maintenance cost of about 5% per year of the capital investment.

Although in this article we have used our particular plan as an example, we feel this plan, properly organized, can work effectively in any similar plant employing 100 or more maintenance people. We also believe that an area foreman type organization in a plant this size or larger is a must to attain efficiency and give the operating group the best service.

Our production people would not permit the maintenance people to reorganize as they were five years ago.

This Month's M&C Feature Panelist

Mr. Wilks

Mr. Herschel V. Wilks received his education in Oklahoma. From 1928 to 1935 he was at Seminole, Okla., with the Sinclair Oil Co. Natural Gasoline Div. as repairman, operating engineer, chief repairman and asst. supt.

From 1935 to 1941 he was with the Cities Service Oil Co. Chemical Division at Seminole as asst. plant supt. Then Mr. Wilks joined Spencer Chemical Co. in Pittsburg, Kans. as mechanical supervisor in a plant making ammonium nitrate, nitric acid and ammonia.

In 1944 Mr. Wilks joined Celanese, holding positions of asst. mechanical supt., and mechanical supt., receiving his present position of manager—engineering and maintenance in 1954.

TURN PAGE FOR M&C PROBLEM CORNER →

The MC Problem Corner
Petroleum Processing's Maintenance and Construction
Panel answers your questions in this regular monthly feature.

How to remove deposits from . . .

Steam Turbine Blades And Vacuum Ejectors

What methods are there for cleaning deposits from steam turbine blades with a minimum of downtime? Can these blades be cleaned in place without dismantling the turbine?
Refining, Gulf Coast.

THERE are several methods of cleaning deposits from steam turbine blading, some without dismantling the turbine.

One thought to keep in mind is that if the water supply had been properly prepared, the boiler properly operated, and if the steam generator has well designed and effective steam purifiers, there should be no deposits.

Water-soluble deposits are relatively simple to remove. Many installations simply provide a suitable water supply at or near the turbine steam chest and facilities for collecting and removing the wash.

One suggested method introduces wet steam into the turbine. For superheated steam turbines, a mixture of steam and water is used. The turbine is brought up to 10-15% of normal speed with exhaust steam to atmosphere and all casing drains opened slightly. The hot water is admitted slowly to prevent excessive thermal stresses on the turbine elements. When using superheated steam, the water rate should be such that steam temperature is reduced about 200°F/hr until saturation temperature is reached.

After saturation temperature is reached, conditions are held constant for one-half hour. Then the water rate is increased until the discharge from the turbine shows a mixture of steam and water. Casting drains are then closed, leaving exhaust drains open.

Another cleaning method does not take the turbine out of service. A ½-in. line is installed from the boiler-feed water line to the steam inlet of the turbine on the downstream side of the steam control valve.

Double block and bleed valves are installed to assure a flow of clean, hot feed water by flushing out the line before injecting the water. A 1/16 orifice union is installed in the line near the injection point to control the flow of water. The water is introduced as needed by manually controlling the block valves.

At another Panel Member's refinery, cleaning water-soluble deposits from single wheel impulse turbines at temperatures below 450°F is done effectively with a water wash. Water in small amounts is injected into the turbine nozzle chamber and against the blades without stopping the turbine. All turbine drains are open. Water is directed into the blading and not against the turbine wheel.

In another location, large turbines are cleaned satisfactorily by shutting the turbine down and letting it cool for three hours. Then, slow rotation is started and the casing filled with condensate to the shaft level. Rotation is continued for 15 minutes, after which the turbine case is drained, while continuing turbine rotation.

Analysis of scale treated is:

NaOH	11.1%
Na_2CO_3	5.84%
Na_3PO_4	0.59%
Na_2SO_4	10.24%
Na_2SiO_3	18.92%
NaCl	49.40%
Insolubles	1.30%

Onstream cleaning also is reported by another Panel Member, who suggests injection of boiler feed water into steam inlet of the turbine while the turbine is in operation.

Two precautions when cleaning turbine blades. Vibration readings should be taken before and after washing to detect any changes in vibration that might result from the removal of the deposits. Also, it is often a good idea to consult the turbine manufacturer before installing water washing facilities on the turbine.

What is the best way to clean venturis on vacuum distillation unit ejectors? Can these be cleaned in-place?
Refining, West Coast

SERIOUS fouling of steam ejectors for vacuum distillation towers should not be a problem if the equipment is properly installed and protected. If steam quality is controlled (by water treating, etc.), and there is proper use of wire mesh de-misters and internal coolers in the original design of the tower, there should be little occasion to clean this equipment.

Common practice is to install surface condenser ejectors in duplicate. Thus, when properly valved, they can be acid or Oakite cleaned without removing them. A small portable circulation unit is used, such as often applied in cleaning bearing cooling channels, compressor jackets, etc. One section is valved off and cleaned at a time.

Another Panel member suggests that unless the deposits (assumed to be scale from dirty steam and cooking out entrained oil in the non-condensibles, and steam from the vacuum tower) are severe, they can best be removed mechanically, with the equipment in place.

If the deposits are severe, and the equipment is large, it might be more economical to clean by boiling with a caustic-soda solution, or with other detergent solutions. This method has advantages when the barometric seal leg is also badly fouled.

A more satisfactory cleaning job is had by placing a choke or restriction orifice in the bottom of the seal leg; circulating the cleaning solution from the hotwell, by a pump, through the steam line to the jets; thence through the venturi, barometric and secondary equipment; and back to the hotwell via the seal leg.

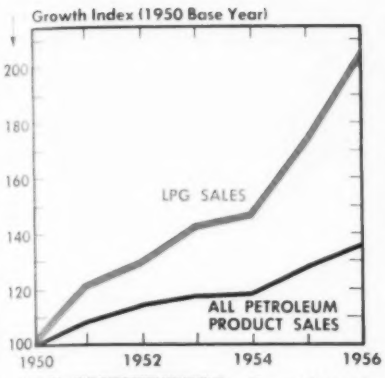
In some jobs, it is impossible to clean the ejectors by other than actual removal and descaling with compressed air and wire brush.

NEXT MONTH: The M&C Panel tells how to clean insoluble deposits from steam turbine blades.

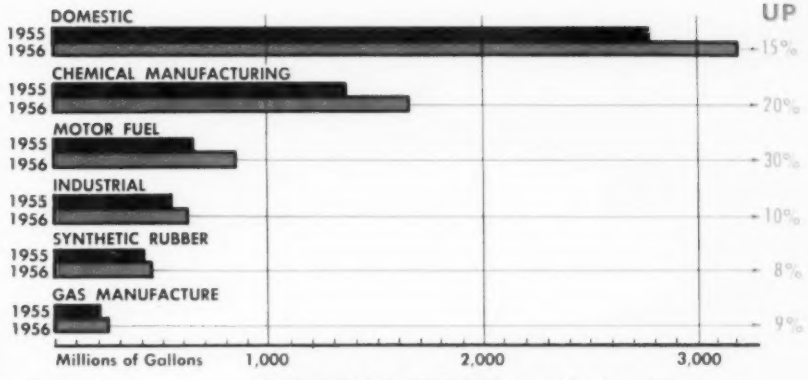
Got a Problem?

Why not send it to the M&C panel. Your questions should be specific, and on maintenance and construction. Include a sketch or photo if needed. But please limit each question to one subject. Address them to:

M&C Editor
PETROLEUM PROCESSING
330 West 42nd Street
New York 36, N. Y.



LPG OUTSTRIPPED all products in growth rate



. . . **AS DEMAND SURGED** in 1956 for all end uses

LPG—Largest Petroleum Growth

SALES of liquefied petroleum gas jumped by over one billion gallons this past year to reach an estimated total consumption of almost 7 billion gallons.

This 16.1% increase over 1955 is almost as large as the 17.2% increase registered for 1955 over 1954. Demand for LPG has doubled since 1950 and outranks total growth for all petroleum products by almost 300%. (See index chart above.)

Figured in barrels, 1956 LPG sales were 455,000 per day—more than the total barrels of kerosine marketed. LPG now ranks fourth in volume among petroleum products consumed by the public, exceeded only by gasoline distillate fuel oil and residual fuel oils.

In 1957 this phenomenal growth is expected to continue. The use of LPG as a motor fuel in trucks and buses is expanding rapidly, and the new federal highway program is expected to provide further motor fuel applications in highway construction equipment. "Weather" conditioning—both heating and cooling—will offer new markets for LPG, while chemical uses should continue their growth of the past few years.

The growth of total LPG sales in 1956 was spread between all of its many uses:

Motor fuel sales increased almost 27%, the largest gain of any single use. Although the volume (850 million gallons) was only the third largest of LPG uses, it is expanding rapidly.

Domestic uses (home heating, appliances, etc.) increased 15% in 1956, requiring 3,218 million gallons to satisfy this largest of all demands.

Chemical manufacturing used 20.1% more in spite of the steel strike that delayed the construction of new chemical plants. Total demand for this use was 1,642 million gallons.

Industrial and miscellaneous uses increased in 1956 by 10.4% to 614 million gallons. Its gains outstripped that of general industrial activity.

Synthetic rubber production required 8.1% more LPG this last year, after a very large 32% gain in 1955. Total gallonage was 439 million.

Gas manufacturing consumed 9.5% more LPG in 1956 than in 1955—a total of 234 million gallons.

Adequate supplies of LPG to meet the growing need are insured by new plant construction and additions to existing plants. Twenty-six new plants came onstream in 1956 to boost total production capacity by 1,120,000 gal/d. Fifteen new plants are expected to add another 750,000 gal/d in 1957, with 75% of the LPG produced coming from natural gasoline plants. In 1956 more than 50% of the liquids produced at natural gasoline plants was LPG.

Storage capacity is expected to continue to keep pace with LPG production, both above ground and underground. Estimated capacity of underground storage installations now totals almost 1 billion gal (24 million bbl). A third more is in the planning or construction stage.

Sales of LPG for motor fuel in internal combustion engines, which amounted to 850 million gal in 1956, represented 12% of total LPG sales. Significant is the rapid growth of this outlet in all sections of the country, the biggest users being trucks, buses, tractors, industrial trucks, and irrigation and drilling engines.

About 2,000 LPG-fueled buses were in operation at the beginning of 1956, with another 250 factory-equipped LPG buses scheduled for delivery in 1956 and early 1957. LPG tractors produced during the year numbered 12,200. Although this is a small proportion of the total tractor output, it is significant that LPG tractor production increased, while that of gasoline and diesel tractors decreased in 1956. Conversions of farm tractors to LPG were 45,000 last year, making a total of 303,000 LPG tractors in use. The conversion of trucks continues as more LPG service stations become available to take care of this market.

One thing needed to spark greater use of LPG in trucks is the design of engines that can fully utilize the advantages of LPG. To date, only one manufacturer is building truck engines specifically for LPG; the others use modified gasoline engines.

In the domestic market the largest single factor is house heating. As more people become familiar with the convenience of gas, through the extension of natural gas pipelines, they realize the availability of LPG. It is popular in new housing developments as central heating becomes more widespread in new homes and remodeling programs. Farmers are also finding increased use for this fuel outside the house for crop dehydration, flame weeding, chicken brooding and other uses.

For chemicals: Even though the steel strike delayed construction of many new plants in 1956, the sales of LPG as a raw material for the

Principal uses of liquefied petroleum gas

(1000 Gallons)

Year	Total	% Change	Domestic & Motor Fuel[A]	% Change	Indust. Misc.	% Change	Gas Mfg.	% Change	Chem. Mfg.	% Change	Synthetic Rubber	% Change
1950	3,482,567	22.8	2,022,464	24.3	355,456	[B]	251,694	5.2	624,468	14.6	228,485	28.5
1951	4,227,275	21.4	2,456,804	21.6	269,408	[B]	281,692	11.9	844,507	35.2	374,864	64.1
1952	4,477,379	5.9	2,636,736	7.4	338,959	26.0	259,697	— 7.8	870,990	3.1	370,997	— 1.1
1953	4,932,009	10.2	2,977,418	12.9	374,233	1.04	222,430	—14.4	967,427	11.1	390,501	5.3
1954	5,125,533	3.9	3,174,012	6.6	401,615	7.3	191,932	—13.7	1,050,239	8.6	307,735	—21.2
1955	5,996,483	17.0	3,453,200	8.8	556,371	38.5	213,760	11.4	1,366,942[C]	30.2	406,210	32.0
1956	6,997,000	16.7	4,068,000[D]	17.8	614,000	10.4	234,000	9.5	1,642,000	20.1	439,000	8.1

(A) Household plus other uses such as irrigation pumping, tractor fuel, flame weeding, and chicken brooding. Includes LPG sold by domestic distributors; also that sold direct by producers and marketers solely for fueling internal combustion engines.

(B) Not comparable because of change in method of reporting LPG sold for refueling internal combustion engines.

(C) Includes more complete coverage of LPG mixture streams containing ethane and methane.

(D) Of this total, 850 million gallons was motor fuel.

Remarks: Total sales for all years except 1956 were obtained from U.S. Bureau of Mines reports; also distribution for the years 1950 to 1955 inclusive. All other volumes were estimated by the writers.

The total sales volume includes all LP-Gas (propane, butane, and propane-butane mixtures) when sold as such. It does not include butane when blended with heavier petroleum fractions for motor gasoline purposes. Inter-company sales transactions such as purchase of LPG by one company and its resale as LPG by the same company have been eliminated.

manufacture of chemicals and chemical intermediates continued to grow at a rapid rate. Total volume was 1.642 billion gal. The gain was sparked by a growing demand for LPG in the manufacture of polyethylene. Other large outlets were in the production of butadiene and styrene for chemical intermediates and synthetic rubber. Large volumes were also used in the production of phenols, acetones, glycols, amines, detergents, additives, alcohols, and the like.

The use of LPG streams containing methane and ethane as feed stocks for petrochemical plants increased at a rapid rate in 1956, so much so that these volumes are now included in the Chemical Manufacture category.

In industrial and miscellaneous uses, part of the 10.4% increase of LPG was caused by the inclusion of refinery fuel gases containing LPG in this category. However, it does not account for all of the increase. Another factor in the demand for LPG as an industrial fuel is the addition of standby plants as protection against winter shutdowns of the natural gas supply.

In addition to the increasing use of LPG for gas manufacturing—9.5% greater in 1956—there is considerable interest being shown in reforming LPG for utility gas purposes.

Acknowledgment

This article is based on the statistical report on liquefied petroleum gas sales prepared annually by Phillips Petroleum Co. This 1956 report was prepared by George R. Benz, manager, engineering department; Paul W. Tucker, technical representative, engineering department; and W. F. DeVoe, manager of LPG sales, sales dept., all with Phillips Petroleum Co., Bartlesville, Okla.

LPG Makes the Grade as Bus Fuel

FROM EXPERIENCE gained in operating LPG-powered buses over 169 million miles, automotive engineers with the Chicago Transit Co. have compared LPG with other fuels. Their comprehensive 6-year study, which included 1650 buses now in operation, makes these five points:

Initial engine cost and life: CTA enjoyed savings of approximately $2200 on each LPG-powered bus, essentially the difference between the cost of a diesel and propane powered unit. From a study of buses in use since 1950-51, 200,000 miles per unit were experienced without an engine rebuild. Other type fueled engines normally require new rings at 160,000 miles.

Maintenance: Records to date indicate the cost of maintaining an LPG fueled engine is lower than other types. The reasons for this include very light carbon formation, and slight piston and wall wear. The cylinder walls remain well lubricated because fuel dilution and crankcase contamination are limited. With LPG there is no drop-out of hydrocarbons to create sludge in the crankcase nor varnish to coat the carburetor manifold or other engine parts.

Although gasoline carburetors require cleaning and rebuilding every 30,000 miles, LPG carburetors operated 72,000 miles between rebuilds. Spark plug life on the propane-fueled engines is 24,000-32,000 miles compared with 8,000-12,000 miles on gasoline fueled engines. Muffler life is also considerably higher.

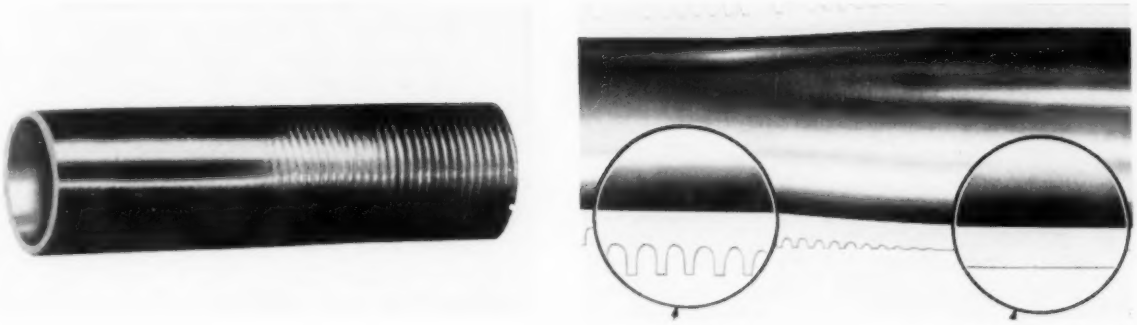
Operation: Because the octane rating of LPG is higher than gasoline, (approximately 125 on straight propane) higher compression ratios can be used. And the ignition can be advanced so that more power per pound of fuel is obtained on the same size engine. By both test and operation, LPG power plants are much quieter in operation than engines using other fuel. Because LPG buses are also exhaust smoke- and odor-free, they have considerably more driver appeal than buses using other fuels.

Oil consumption: Records substantiate that oil consumption on LPG fueled engines is substantially lower than with engines using other fuels. Engine oil life is tripled. The drain period with propane fueled engines is 16,000 miles, with diesel fueled engines from 4000 to 6000 miles.

Fuel cost is more: The propane engine with comparable power characteristics of a diesel engine will require more fuel per mile. Records of the Chicago Transit Authority, by actual, precisely controlled tests, indicate that 25% less miles on propane can be expected. "For successful operation the potential user should investigate the cost differential between LPG and other fuels in his particular operating area," it reports.

The report on LPG operations of the Chicago Transit Authority was presented in a paper entitled "169,000,000 Miles in Chicago with LPG," by Stanley D. Forsythe, general superintendent of engineering for CTA, at the annual meeting of the Society of Automotive Engineers, Detroit, Jan. 14-18, 1957.

Part I–Extended Surface Characteristics and Calculations



THIS IS LOW-FINNED TUBING and sectional view in photo at right shows details

Low-Finned Exchanger Tubing

. . . heat transfer coefficients and other basic information for the design engineer

The development of low-finned tubing (shown in the illustration above) has meant designers of shell-and-tube heat exchangers can take advantage of extended surface in smaller diameter tubes.

Such fins, however, have brought some new problems into design calculations. Author Newell—in this first of a series of three articles—helps the designer work with this type of tubing. He introduces you to some of the characteristics of extended surface and their effects on heat transfer calculations.

In Part 2, scheduled for publication in the next issue of PETROLEUM PROCESSING, the operation of some petrochemical process condensers using low-finned tubing will be discussed. In addition, design methods will be outlined, and these methods checked against the actual performance of the condenser. Part 3 will present design procedures for finned convection heat transfer, shell side.

By ROBERT G. NEWELL, Chief Engineer
Unifin Tube Co., London, Ont.*

THE development of a low-finned tubing with integrally formed spiral fins has permitted the advantages of extended surface to be applied to shell and tube exchangers. Savings in heat exchanger costs are possible through the use of this low finned tubing since the increased external heat transfer surface reduces the quantity of tubing required. New heat exchangers for services where low-finned tubing is properly applied can be built smaller with fewer tubes, at a lower initial cost. Nor can the possibility be overlooked of a cost saving by retubing an existing exchanger with low-finned tubing to gain greater capacity, instead of buying a new larger exchanger.

The tubing, shown in the photograph, has 16 or 19 fins/inch, extruded from thick walled tube to a height slightly less than 1/16 inch. These fins give the tubing an external surface 2½ times that of a bare tube of the same nominal outside diameter. The construction of the tube is illustrated by the section view at the right above. The ends of the tubes are left without fins and

*Since authoring this series of articles, Mr. Newell has become associated with Dutton-Williams Brothers Ltd., Calgary, Alberta.

Nomenclature

The symbols listed in this table are the same as those used in commercial publications[12, 14].

A = Total outside tube area in heat exchanger, ft².

A_{ft} = Area of finned surface of finned tube, ft², for low-finned tubing.

A_i = Inside tube area, ft²/ft of tube length.

A_o = Outside tube surface area, ft²/ft of tube length.

A_{rt} = Area of root tube or prime surface of finned tube, ft², for low-finned tubing.

A_m = Logarithmic mean metal area, ft²/ft, between D_o and D_r.

a_x = Projected area of cross section of low-finned tubing at fin, in.².

C_1 = Correction factor for multitube condensing.

C_2 = Correlating factor in convection coefficient calculation.

C_p = Specific heat of fluid. Btu/(lb) (°F).

D_{eq} = An equivalent diameter of a finned tube for calculation of condensing coefficients.

D_e = An equivalent diameter for finned tube equal to the diameter of a hypothetical bare tube with the same inside diameter and the same volumetric displacement (or with the same plane projection) as the finned tube, in feet. See also d_e.

D_i = Inside tube diameter, feet.

D_o = Diameter over the fins, feet.

D_r = Finned tube root diameter, feet.

d = Outside diameter of plain end of finned tube, inches.

d_e = Same as D_e (inches).

d_i = Inside tube diameter, inches.

d_o = Diameter over the fins, inches.

d_r = Finned tube root diameter, inches.

e_f = Fin efficiency (factor) in decimal equivalent.

G = Mass velocity, lbs/(hr) (ft²).

g_c = Conversion factor, (lb mass) ft/mass) ft/lb/force) sec².

h_f = Outside film coefficient on finned surface only of finned tube, Btu/(hr) (°F) (ft²).

h_i = Inside film coefficient, Btu/(hr) (°F) (ft²).

h_o = Outside film coefficient corrected to base of fin, Btu/(hr) (°F) (ft² outside area).

h_o'' = Outside film coefficient, Btu/(hr) (°F) (sq ft of outside surface), based on total outside fin tube area (uncorrected for fin efficiency).

h_t = Outside film coefficient on root tube or prime surface only of finned tube, Btu/(hr) (°F) (ft²).

K_m = Thermal conductivity of tube metal.

k = Thermal conductivity, (Btu) (ft)/(hr) (ft²) (°F).

L_{ft} = Finned length of tube, equal to L_t less total length of plain ends and lands, feet.

L_h = Mean effective fin height, feet.

L_t = Total tube length, ft (includes plain ends/and land if used).

n_{tc} = Number of tubes required for condensing.

P = Tube pitch, center to center distance between adjacent tubes, inches.

Q = Total heat load, Btu/hr.

q_{ft} = Heat flow to fin surface, Btu/hr.

q_{rt} = Heat flow to unfinned surface of base tube, Btu/hr.

R_e = Reynolds number.

r_i = Inside fouling resistance, (hr)(°F) (ft²)/Btu.

r_f = Fin metal resistance, (hr) (°F) (ft²)/Btu.

r_o = Outside fouling resistance, (hr) (°F) (ft²)/Btu.

r_m = Tube metal resistance, (hr) (°F) (ft²)/Btu.

S = Specific gravity of fluid.

ΔT = Temperature difference, °F.

T_s = Local average bulk temperature of shell fluid, °F.

t_{mf} = Point metal temperature of fin, °F.

t_{mr} = Point metal temperature at root of fin, °F.

Δt_{cf} = Temperature drop across the condensate film, °F.

U_d = Overall design (service) coefficient of heat transfer, Btu/(hr) (°F) (ft² outside surface).

W_s = Total flow to the shell, lbs/hr.

W_{sc} = Total flow to the shell that is condensed, lb/hr.

W_1 = Condensate loading, lbs/(hr) (ft) of finned length of tube.

X_f = Wall thickness of finned tube, inches.

ϕ = Viscosity gradient correction factor $\phi = (\mu/\mu_w)^{0.14}$.

ρ = Density, lbs/ft³.

λ = Latent heat of condensation, Btu/lb.

μ = Viscosity of fluid, lbs/ft—hr.

μ_w = Viscosity of fluid at tube wall temperature, lbs/(ft) (hr).

because the base tube is "sunk" during the extrusion process, the outside diameter of the fins is slightly less than the outside diameter of the bare ends. This allows the tube to be inserted into a tube bundle and rolled into the tube sheet in the usual manner.

A tubular heat exchanger in which low-finned tubing is used is designed by the same procedures that are used to design one with bare tubing. The determination of the individual coefficients is the same for low-finned tubing as for bare tubing. There is, however, a difference between the arithmetic values of the coefficients for the two types of tubing. The net value of the outside coefficient for low-finned tubing depends upon the thermal pattern in the fins and upon characteristics which will be explained in Parts 2 and 3 of this series of articles. Also, the values for the wall conductance, internal fouling

Table 1—Physical Data for Low-Finned Tubing for Use in Design Calculations

1	2	3	4	5	6	7	8	9	10	11
d Specified Out. Diam. Inches	x_f Nominal Wall, Stubbs Ga.	A_o	A_o/A_i	d_e	$\left(\frac{A_o}{D_{eq}}\right)^{1/3}$	$\frac{A_o}{A_m}$	a_x	Vel. Factor	d_i	$d_i^{0.2}$
19 Fins/inch—Copper; Aluminum; 90-10 Cupro-Nickel; Nickel; 70-30 Cupro-Nickel; 85-15 Red Brass; Steel										
⅝	18	0.405	3.86	0.535	3.89	3.45	0.296	2.53	0.401	0.833
⅝	16	0.405	4.19	0.535	3.89	3.58	0.296	3.00	0.369	0.819
¾	18	0.496	3.59	0.660	4.11	3.31	0.429	1.47	0.526	0.879
¾	16	0.496	3.84	0.660	4.11	3.42	0.429	1.66	0.494	0.868
¾	14	0.496	4.14	0.660	4.11	3.54	0.429	1.94	0.458	0.855
1	16	0.678	3.48	0.910	4.44	3.22	0.768	0.735	0.744	0.943
1	14	0.678	3.66	0.910	4.44	3.30	0.768	0.813	0.708	0.933
19 Fins/inch—Admiralty										
⅝	16	0.368	3.80	0.547	3.89	3.16	0.295	2.75	0.385	0.826
¾	18	0.438	3.09	0.675	4.11	2.76	0.427	1.39	0.541	0.884
¾	16	0.438	3.28	0.675	4.11	2.93	0.427	1.57	0.510	0.874
¾	14	0.438	3.53	0.675	4.11	3.03	0.427	1.82	0.474	0.861
1	16	0.598	3.01	0.930	4.44	2.77	0.765	0.707	0.760	0.947
1	14	0.598	3.16	0.930	4.44	2.84	0.765	0.779	0.724	0.938
16 Fins/inch—Type 304 Stainless Steel; Monel; Aluminum Brass										
⅝	16	0.368	3.84	0.540	3.65	3.31	0.292	3.06	0.365	0.818
¾	16	0.438	3.42	0.665	3.87	3.03	0.424	1.70	0.490	0.867
¾	14	0.438	3.68	0.665	3.87	3.13	0.424	1.98	0.454	0.854
1	16	0.598	3.08	0.917	4.22	2.85	0.762	0.745	0.740	0.942
1	14	0.598	3.24	0.917	4.22	2.91	0.762	0.822	0.704	0.932

Notes on Table 1

1. Columns 1 and 2 are nominal size dimensions.
2. Column 3 gives the outside area in sq. ft./ft. of length.
3. Column 4 gives the ratio of outside to inside surface area.
4. Column 5; d_e is an equivalent diameter for the finned tube equal to the O. D. of a hypothetical bare tube of the same inside diameter and the same plane projection (or same volumetric displacement), in inches.
5. Column 6, $(A_o/D_{eq})^{1/3}$ is a value used in the equation for condensing coefficients.
6. Column 7 is the ratio of outside area to logarithmic mean metal wall area.
7. Column 8, a_x is the cross-sectional area, in square inches, of a tube with diameter d_o.
8. Column 9 is a factor to facilitate the calculation of fluid velocity in low-finned tubing. Velocity, fps=U.S. gal. per min. per tube × Velocity Factor.
9. Column 10, tube inside diameter, inches.
10. Column 11, inside diameter, raised to a power used to calculate tube-side water film coefficients.

resistance and the internal film coefficient are subject to the penalty of the greater outside-to-inside area ratio.

To confirm the design relations for low-finned tubing and evaluate the mathematical differences, Katz and his co-workers [2, 5, 6, 7, 10, 13, 15] have carried on considerable research and published numerous papers. Commercial publications [12, 14] have consolidated the available information (up to early 1954) on the design of tubular exchangers using low-finned tubing.

Recent studies by the author, summarized in this paper, have made possible a more direct way of compensating for the thermal resistance encountered in the fins.

Overall Equations for Thermal Design

The fundamental relationship[11] which is the basis of the final selection of a heat exchanger size applies for low-finned tubing, as it does for bare tubing. This is:

$$Q = U_d A \Delta T \quad \ldots\ldots\ldots\

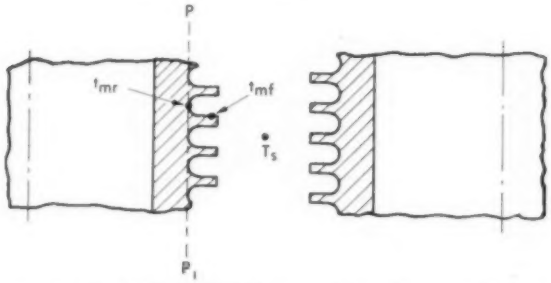


Fig. 1—**PLANE SECTION** through low-finned tubes in a tube bundle

tubing, presented in this paper. r_f is in terms of the total outside area.

h_o'' = the outside film coefficient of heat transfer at the outside surface of low-finned tubing.

These and the other symbols are defined in the nomenclature table. The nomenclature used throughout this paper is the same as that used in recent commercial publications[12, 14].

Table 1 gives dimensional data required in the design methods set forth in this paper. For additional dimensional data on low-finned tubing, reference should be made to the commercial publications[12, 14].

An Explanation of Fin Efficiency

Fins increase the external heat transfer surface of low-finned tubing, but the increase in heat transfer is not proportional to the increase in surface. An important phenomenom which must be illustrated is that the effective heat flux through the finned surface is not as great as through the unfinned surface of the base tube.

Fig. 1 represents a plane section through the axes of two adjacent low-finned tubes in a heat exchanger. The shell fluid is assumed to be the hot fluid. A plane *P-P1* along the base tube outside surface and under the fins is imagined: t_{mr} is the temperature of the tube wall metal at this hypothetical plane: t_{mf} is a spot temperature on a fin.

The heat which flows through the fin surface is conducted along the fin to the plane *P-P1*. It is known from the principle of heat transfer by conductance that t_{mf} must be higher than t_{mr} in order that the heat flow overcome the fin metal thermal resistance.

The temperature difference ($T_s - t_{mf}$) between the shell fluid and the fin is less than the temperature difference ($T_s - t_{mr}$) between the shell fluid and the base tube. The heat flux (heat flow per unit of surface) for the fins is

$$q_{ft}/A_{ft} = h_o'' \cdot (T_s - t_{mf}) \quad (3)$$

which is less than the heat flux to the unfinned portion of the base tube:

$$q_{rt}/A_{rt} = h_o'' \cdot (T_s - t_{mr}) \quad (4)$$

Equation (3) is rearranged as Equation (3a):

$$q_{ft}/A_{ft} = h_o'' \cdot \left(\frac{T_s - t_{mf}}{T_s - t_{mr}}\right) \cdot (T_s - t_{mr}) \quad (3a)$$

which gives the heat flux to the fin in terms of the heat flux to the base tube with a correction factor

$$\left(\frac{T_s - t_{mf}}{T_s - t_{mr}}\right)$$

to adjust for the actual temperature difference. Equation (3a) defines the effective rate at which heat arrives at the plane *P-P1* from the fin surface.

In the preceding explanation, a spot temperature on the fin, t_{mf}, was considered. Actually, the temperature varies along the fin so that the correction factor must be integrated over the whole surface of the fin. Fortunately, this has been done by Gardner[4] for a variety of fin types. Gardner derived generalized relationships which are used to calculate a weighted correction factor applicable to the whole fin surface. This correction factor has been conventionally called the "FIN EFFICIENCY." Gardner found that the factors determining fin efficiency were the thermal conductivity of the fin metal, the fin geometry and the heat transfer coefficient at the fin surface.

Fig. 2 plots the fin efficiency (symbol e_f) as a function of a modified heat transfer coefficient for low-finned tubes in eleven metals. The modified coefficient will be explained later.

As can be seen from Equation (3a), it would be equally possible to apply the correction factor to the area, if it were transposed, or to the film coefficient of heat transfer. For design work, it is more convenient to apply it to the film coefficient. The actual heat transfer through a fin is therefore determined in terms of an "effective" (or reduced, or corrected) film coefficient of heat transfer

$$h_{oft} = h_o'' e_f \quad (5)$$

A weighted value of the net film coefficient of heat transfer over the whole tube surface is evaluated from the equation

$$h_o = \frac{h_o'' e_f A_{ft} + h_o'' A_{rt}}{A_o} \quad (6)$$

Equation (6) is the fundamental equation for use in the determination of heat transfer for extended surfaces. It is the basis for other derivation including the new fin metal thermal resistance technique for low-finned tubing presented in this paper. For the film condensation of vapors on low-finned tubing Robinson and Katz[10] combined Equation (6) with the Nusselt[9] equation. This combined equation gives a direct solution for the corrected outside film coefficient. (See also references 12 & 14.)

Fin Metal Thermal Resistance

As shown in the previous paragraphs, the fin metal thermal resistance has the effect of reducing the film coefficient of heat transfer at the tube outside surface to an effective value as determined by Equation (6). The fin metal thermal resistance is then defined by Equation (7):

$$r_f = \frac{1}{h_o} - \frac{1}{h_o''} \quad (7)$$

The use of Equation (6) is an indirect solution for the effect of fin metal thermal resistance. A direct solution for r_f for use in Equation (2), thereby eliminating Equation (6), would be an improvement in the design technique.

The idea of evaluating the fin resistance as a component to be used in a form of Equation (2) was introduced by Carrier and Anderson[3] in 1944. These authors applied the idea to the evaluation of air conditioning heat exchangers. They presented a form of Equation (8), but did not derive it.

$$r_f = \frac{1}{h_o''}\left[\frac{1 - e_f}{e_f + \frac{A_{rt}}{A_{ft}}}\right] \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (8)$$

In Appendix A of this article, Equation (7) and (6) have been combined to derive Equation (8).

In industrial heat exchangers, there will always be a coating of scale or fouling on the outside of the tubes. The thermal resistance of the scale is allowed for by the use of a fouling factor r_o in Equation (2).

Gardner's[4] derivations showed that one factor determining fin efficiency was the film coefficient of heat transfer at the fin surface. In exchangers then, the fouling introduces an additional thermal resistance which reduces the rate of heat delivery to the fin surface and consequently affects the fin efficiency. That is, in the evaluation of fin efficiency, a Modified Outside Film Coefficient should be used equal to

$$\frac{1}{1/h_o'' + r_o}$$

In an unpublished derivation by Young and Katz,[16] it has been shown that for a fouled tube the correct value of r_f is given by Equation (8a):

$$r_f = \left[\frac{1}{h_o''} + r_o\right]\left[\frac{1 - e_f}{e_f + A_{rt}/A_{ft}}\right] \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (8a)$$

This equation (8a) is used to derive values of fin resistance for low-finned tubing for heat exchanger design purposes.

The resistances are calculated from fin efficiency values which are determined using the Modified Outside Film Coefficient. When determining r_f in design calculations, this same Modified Coefficient must be used as the abscissa value.

In Fig. 3, the fin resistance as calculated by Equation (8a) is plotted against the Modified Outside Film Coefficient. For low-finned tubing, A_{ft} and A_{rt} are 80% and 20% respectively of the total outside area so that $A_{rt}/A_{ft} = 0.25$. Using the e_f values from Fig. 2, it is possible to evaluate the resistance for a wide range of values of the modified coefficient for eleven metals. Fig. 3 is suitable for design work.

Because Equation (8a) and Fig. 3 are now available, the use of Equation (6) as such is no longer necessary. Equation (6) is actually incorporated in Equation (8a).

The advantage of this new method will be seen by those experienced in the design of exchangers using low-finned tubing. Or, it can be seen after a study of the literature listed in the bibliography. All the methods of determining film coefficient—for instance, the condensing film coefficient—have required that the fin efficiency be intricately involved in the calculation.

This is not so with the new method. The film coefficient is determined as it occurs without modification and for the total finned tube outside area. This value is inserted in Equation (2) directly. Then the fin metal thermal resistance is determined from Fig. 3, and is also included in Equation 2.

As can be seen from Fig. 3, the actual values of fin resistance for low-finned tubing are really quite low.

(Continued on p. 77)

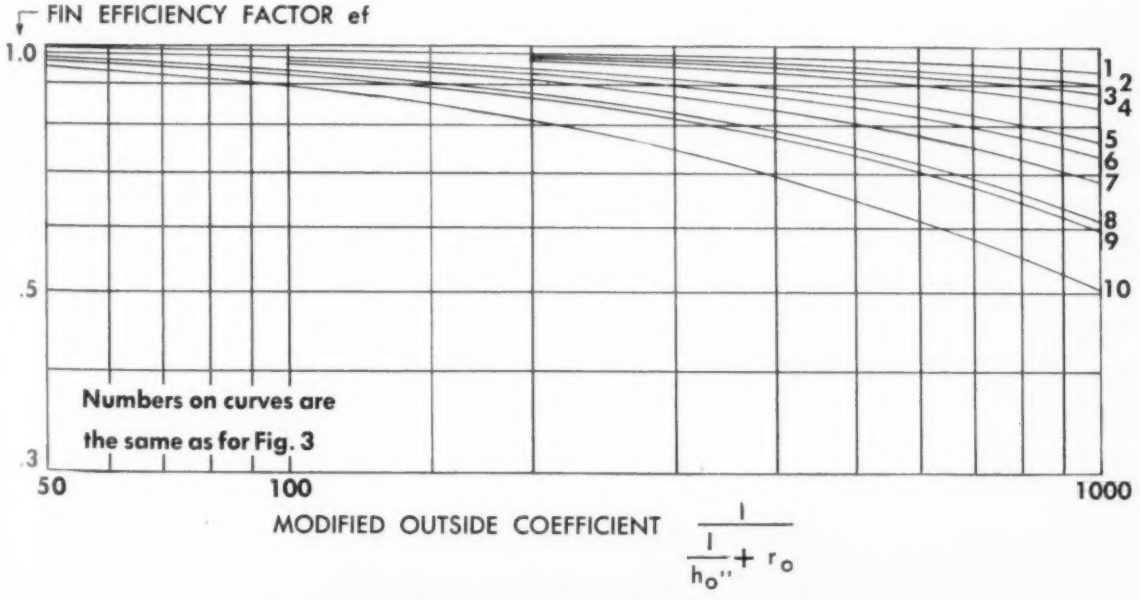


Fig. 2—**FIN EFFICIENCY** for low-finned tubing

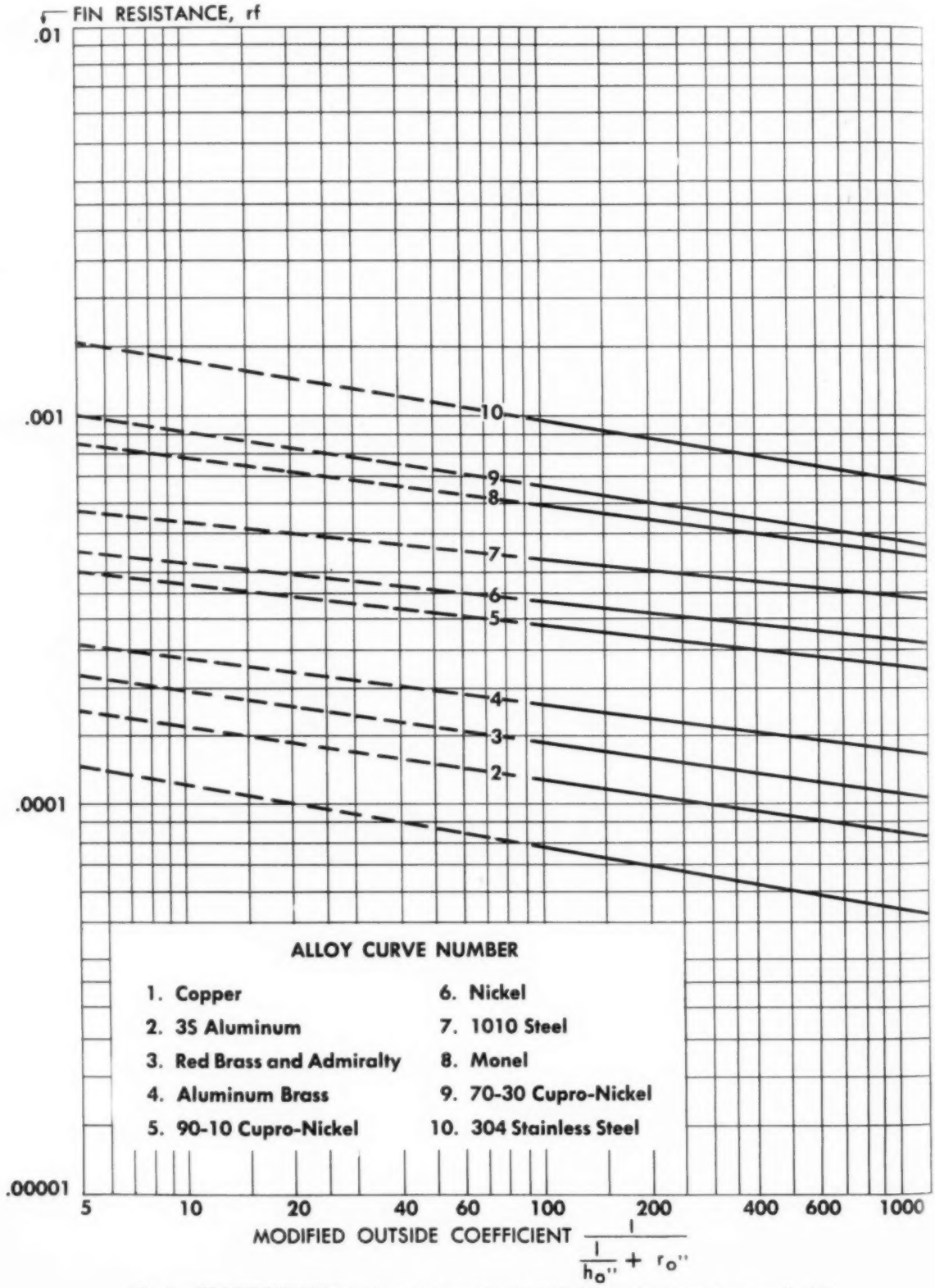


Fig. 3—**FIN RESISTANCE** values for low-finned tubing (19 or 16 fins/inch as applicable)

Appendix A

Derivation of the Relation for Fin Metal Thermal Resistance

It was shown in the preceding text that the heat flux to the fin surface is less than the heat flux to the root area because of the fin metal thermal resistance.

This difference in heat flux is shown mathematically in heat transfer design calculations by the difference between h_o'', the actual film coefficient of heat transfer at the surface, and h_o, the corrected film coefficient. The fin metal thermal resistance is the difference between the inverse of these two values, i.e.:

$$r_f = \frac{1}{h_o} - \frac{1}{h_o''} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

$$= \frac{h_o'' - h_o}{h_o'' h_o} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7a)$$

but:

$$h_o = \frac{h_o'' e_f A_{ft} + h_o'' A_{rt}}{A_o} \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

$$= h_o'' \left[\frac{e_f A_{ft} + A_{rt}}{A_o}\right] \quad \ldots\ldots\ldots\ldots\ldots\ldots (6a)$$

Substituting (6a) in (7a):

$$r_f = \frac{h_o'' - h_o'' \left[\dfrac{e_f A_{ft} + A_{rt}}{A_o}\right]}{(h_o'')^2 \left[\dfrac{e_f A_{ft} + A_{rt}}{A_o}\right]}$$

$$= \frac{1 - \left[\dfrac{e_f A_{ft} + A_{rt}}{A_o}\right]}{h_o'' \left[\dfrac{e_f A_{ft} + A_{rt}}{A_o}\right]}$$

$$= \frac{A_o - e_f A_{ft} - A_{rt}}{\left[\dfrac{e_f A_{ft} + A_{rt}}{h_o'' \ A_o}\right]}$$

$$= \frac{1}{h_o''} \cdot \frac{A_o - e_f A_{ft} - A_{rt}}{e_f A_{ft} + A_{rt}}$$

Meet the Author

Mr. Newell

Robert G. Newell, project engineer, Dutton-Williams Brothers Ltd., Calgary, Alberta, since about mid-1956, was chief engineer, Unifin Tube Co., London, Ont., at the time he prepared the accompanying series of articles.

Mr. Newell had been with Unifin since 1950, during which period his primary responsibilities were in the design, engineering, and development of finned tube heat transfer equipment. He was also a member, and for one year, the chairman of the joint committee on finned tubes of Unifin and its American affiliate, Wolverine Tube, Division of Calumet & Hecla, Inc., Detroit, Mich.

A native of Canada, Mr. Newell received his chemical engineering degree from Queens University, Kingston, Ont., in 1946. He then joined Polymer Corp., Sarnia, Ont., as a process engineer concerned primarily with heat exchange, refrigeration, and fractionation problems. In 1949, Mr. Newell left Polymer for a year's study at the University of Western Ontario, following which he became associated with Unifin.

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WHEELER

McGREGOR

LOGWINUK

MADDOCKS

THORNTON

HAIG

FORTER

HARDCASTLE

BOCHOW

JONES

HOUSER

PETROLEUM PROCESSING tape recorded the last regional meeting of the Western Petroleum Refiners Ass'n in El Dorado, Ark. Here is the first series of technical tips on processing problems from the complete transcript (checked for accuracy by each speaker). Moderator of the panel of authorities that answered all questions was Harry K. Wheeler of Pan-Am Southern Corp., El Dorado, Ark. Members of the panel were: D. W. McGregor, Lummus Co.; Dr. A. K. Logwinuk, Houdry Process Corp.; R. R. Haig, Esso Research and Engineering Co.; A. A. Forter, Cities Service Refining Corp.; C. A. Hardcastle, Lion Oil Co.; Carl E. Bochow, Suntide Refining Co.; Bruce Jones, McMurrey Refining Co.; Mark E. Houser, Republic Oil Refining Co.; R. R. Maddocks, Blaw-Knox Co.; and D. P. Thornton, Jr., Universal Oil Products Co.

This month's technical tips on . . .

Catalytic Cracking Problems

? CO_2 to CO Ratio: What factors affect the CO_2 to CO ratio in cat cracking?

Haig

Haig: We have been trying to study those factors over a great many years, but we can't really pin anything down definitely. Certainly the catalyst you use is one of the big factors.

We've used silica magnesia type of catalyst and a natural catalyst and silica alumina. Probably you all know that they inherently produce a great difference in the CO_2 to CO ratio. There is also an effect of temperature that is perhaps only a theoretical effect. The temperature affects the ratio of CO_2 to CO formed at the actual site of combustion.

If you're like us, though, you measure your CO_2 to CO ratio somewhere up in the stack where you can have all kinds of other effects—including after-burning, which has been one of the principal ones. We've noticed a great variety in this ratio in our plants using exactly the same catalyst from the same supplier. One plant would run a ratio of 1.0 or 1.1. Another might be as high as 1.5. We tried correlating all the operating variables—regeneration temperature, feed stock, per cent coke, excess air, pressure—and none of them showed a significant effect.

We finally took the catalysts out of these units and tried them in a pilot plant at constant operating conditions—controlled conditions. In the pilot plant, the catalysts—all from the same original manufacturer—still showed the same differences in the pilot plant that they had in the plant. So we feel it takes a great deal of nerve to try to put your finger on any operating variable in the plant that affects this ratio.

Gene Norris (Houdry Process Corp.): Houdry's work on the CO_2 to CO has been, of course, with pelleted catalysts. We have had very positive effects of one catalyst type as compared to another. When you first compare only the synthetic catalysts, possibly the differences wouldn't be so sharp. But on a natural clay catalyst we found the CO_2 to CO ratio will consistently run somewhere around 3 to 1. On synthetic catalyst, however, the ratio will run 2 to 1 or slightly under. Although this is found clearly in laboratory work, it is found less clearly in plant practice, of course, because of after-burning.

As far as we can tell, after-burning can be set off by temperature or by presence of very fine particles in such a bed—the fine particles may serve as centers to start ignition—and apparently a lot of the after-burning takes place as the gas disengages from the catalyst bed. Therefore, the unit will have an apparent CO_2 to CO ratio that will vary anywhere from the theoretical to practical disappearance of CO. That, I think, represents our experience on pelleted operation.

Now the same thing is true of differences between pelleted and fluid catalysts on metals: we have certain differences, very basic. We have found that metals are not necessarily bad actors on pelleted catalysts. In the last year we published papers on a new technique we call "Houdresid," which handles metals fairly well. We have been able to charge resid directly to our Houdresid cat cracker. And so the question of the factor of metal can be greatly reduced or eliminated on pelleted catalysts. It can be substantially eliminated, as judged from the hydrogen ratio in our off-gas, or any other factor.

We ran one Houdresid cat cracking unit for approximately a year with feedstock consisting of nothing but topped crude—Mid-Valley pipeline topped crude charge—fifty per cent bottoms on crude.

? Coke and Gas Factors on Catalyst: With regard to coke and gas factors on fluid cracking catalyst, what metals are particularly bad actors?

Haig: I think it's pretty generally agreed that nickel and vanadium are the worst actors. Iron is another one, although I think if you get iron scale coming off your tanks it doesn't seem to have as bad an effect as some of the iron that's in the feed stock. It just tends to flake off. It doesn't get impregnated on the catalyst as well.

? Reducing Coke and Gas on Catalyst: Can the coke and gas factors be reduced or eliminated on fluid cracking catalyst by other than catalyst discard?

Haig: I understand that some people had luck using high quantities of steam but I can't speak from our own experience on that. Our approach is to use all sorts of effort to keep the metals out of the feedstock. That applies, of course, primarily to vacuum distillation. We used a York blanket to get rid of entrainment.

We found later that actual volatility of these metals in the oil can be just as bad an effect as entrainment, so in most of our units the trend has been to go to fractionation—not just the spray deck or side to side type baffle; we put in actual trays with a gas-oil reflux on them. When that's in there, we find that we can knock down the metals that are distilled and we also knock down the entrainment at the same time.

? Analyzing for Coke and Gas on Catalyst: Are there any accepted shortcut methods that may be used for analyzing fluid cracking catalysts for these coke and gas poisons?

Haig: I'm not familiar with any. If you want to find out if your catalyst is being poisoned, though, I think it will show up quickly in your unit, particularly in your hydrogen production. I believe our refineries use the per cent hydrogen in the low pressure gas in the fractionator distillate drum as the measure. As long as that stays down in a low range they don't get worried. If it starts to climb, then they go to more detailed analyses, usually putting more effort on the feed, though, rather than the catalyst. Even if you find it in the catalyst it doesn't help you, you still have to remove the source of it.

Norris (Houdry Process Corp.): For short cuts, analyzing catalysts for the effects of poison in plant practice is a matter of gravity of the gas off the unit and, in laboratory practice, it is usually a matter of spectrographic analysis. A check of the catalyst can be done very quickly, once the sample arrives at the laboratory that's prepared for doing spectrographic work.

? Significance of High Gas and Coke Factors: What is the actual plant significance of coke and gas factors above 2.0?

Haig: I think any of you here can answer that as well as I. You'll start making more gas (specifically more hydrogen) and more carbon—then you're going to have to back off in conversion. I think you all know that it costs money to back off in either conversion or feed rate.

The main point is that it's worth a great deal of money to get the contaminating metals out of your feedstock before they ever get in the unit. We've gone to considerable expense in some of our refineries to do just that. We haven't found any cheaper way and we would be glad to hear of one.

? Continuous Catalyst Addition: Has anyone had any experience with a continuous catalyst addition system in the range of 0.5-1.0 tons per day? How did it affect the operation of the unit, as well as catalyst consumption and activity?

Haig: The answer to that one is yes, we have had experience with 0.5-1.0 t/d continuous catalyst addition. As to how it affected the operation of the unit as well as the catalyst consumption and activity, the best way to operate the unit is to avoid slugs of fresh catalyst, which increase your high fines content and cause you to lose more catalyst, particularly the finer part of the fresh catalyst, out of the stack.

With continuous addition you get a much greater advantage from your fresh catalyst additions and greater efficiency in utilizing the fresh catalyst. You avoid upsets that may be caused by suddenly getting a higher activity catalyst in the unit right after you have made your addition in a short period, such as a half hour.

For units of this size we use a catalyst addition system that was developed by the Ketjen people over in Amsterdam. They make our silica alumina catalyst for us for Europe, Africa and Asia. They developed this system and I believe they are willing to let anyone use it as long as they are written to for permission. I don't think there is any royalty on it, and I think the only requirement is that you have to put their nameplate somewhere on the unit. It is a small price to pay—the benefits are well worth it. We use this on all our small units where the addition rates are down in this range.

For the larger units we have a somewhat cheaper system that we developed ourselves, but ours is not as economical at these low rates.

Norris (Houdry Process Corp.): I would like to make one additional comment, further on the line of continuous catalyst addition to catalytic crackers. We have certainly noted in our systems the same effect of continuous addition being much more favorable than batch addition. It comes around to the matter of having a balanced temperature and a balanced activity throughout the circulation cycle. And while it certainly is not as pronounced, because the time cycle in the Houdriflow unit is more like an hour and 20 minutes or so, it still is there and can be a serious matter if you are running a unit in heat balance, as several of our unit operators are doing.

? Steam to Reduce Gas and Coke Factors: When you reduced your coke and gas factor by the addition of steam, did you do it in the catalyst stripping section in your reactor?

Haig: That was not our own experience. That is something we have heard from other companies and maybe someone here has actually done it. I think you can say that the steam is of some benefit but it is pretty expensive all through the unit, especially if you are running

at capacity in your fractionator and your overhead condenser. Adding steam can be quite a penalty. We've gone the route, as I said, of taking the metals out of the feed, as being the cheapest way in the long run.

Reinkemeyer (Anderson-Prichard Oil Corp.): We have a UOP cat unit on which we have an addition system that doesn't require a nameplate. We've got a five-ton hopper mounted on some scales, and we add our catalyst continuously. It works very well, smoothing out the whole unit all the way down the line, and you never know when you add your catalyst. We'll be glad to show it to anyone.

? Catalyst Stripper Internals: Does anyone have internals in their catalyst strippers—and what type? What criteria were used in sizing the stripper and spacing the internals?

Haig: Maybe this one ought to be reworded—does anyone not have internals in the cat strippers? It is news to me. What criteria were used in sizing the stripper and spacing the internals? This has been a fairly complicated problem with us ever since the first cat units, fluid units, were built about 15 years ago. The battle is still going on.

We like to think of this stripping operation as having as least two factors in it; one is displacing the hydrocarbon vapors that are just entrained down into the stand pipe with the catalyst, the vapors that are separating the particles; the other is the carbon that is actually formed in the stripper from oily materials, perhaps on the catalyst itself, which has the same effect as putting more holding time in the reactor—a higher hold-up.

The first kind that is between the particles is something you can measure by withdrawing samples. You can't measure the second one, you pretty much have to guess at it by figuring the conditions of the stripper, the temperature, and the holding time, the cat to oil ratio—on that little bit of oil in there. From these studies we have come up with a compromise on having a long enough stripper to let us get out all of the vapor that's in between, and yet try not to hold it in there so long that it will keep forming more and more carbon on the particles.

? Fluid Catalyst Coolers: What heat transfer rate is obtained for a catalyst cooler immersed in a fluid catalyst bed when used as a boiler and when used as a steam superheater? Is there any experience in the use of blocked off steam tubes in this type service?

Maddocks

Maddocks: I refer the group here to a brochure, printed by The Babcock and Wilcox Co., concerning CO boilers and heat recovery from fluidized beds. This brochure contains an article written by Oliver Campbell and others of Sinclair Refining Co., who present test data indicating that a heat transfer rate somewhere around 70 Btu's per square foot per degree is available. Now in such an operation the mean temperature difference is somewhere around 400°F, and so you might expect an overall rate of 24,000 Btu/hr sq ft.

Beyond that, I might point out another article written by Dr. Logwinuk (printed in *Industrial and Engineering Chemistry*, in 1949) in which he found that in cooling of fluidized beds, rates of 40 to 90 Btu/hr sq ft per degree were experienced.

Referring to the last portion of this question, concerning experience using blocked-off steam tubes, I might point out that just recently Ashland Oil & Refining Co. has put a new fluid cat cracker on stream. They are using tubes in the regenerator section for preheating feed water in a waste heat boiler system. At the moment, their complete steam generation system hasn't been completed. Nevertheless, they have put the unit onstream and are running with these tubes blocked off, without any difficulty. Therefore, I would say that you could run with these tubes blocked off if you should so desire.

? Feed Line Cracking: Has anyone done feed line cracking? If so, what are the comparative advantages over bed cracking and how does the stability of the gasoline and heavier products compare?

Bochow

Bochow: We feel that feed line cracking does take place in the Suntide unit and that the reactor is simply a disengaging zone for our cracking catalyst. We feel that the cracking is done mostly in the dilute phase before the oil enters the reactor, and that in this way we deposit less carbon on the catalyst. Humble Oil & Refining Co. installed what they called a transfer line reactor in 1953, and they have compiled a lot of data on feed line cracking; however, I don't think they have published any of it. Does anyone have any data on the Humble unit? My last report, in talking to a man from Humble, was that they liked the results very well.

? High and Low Alumina Catalysts: Regarding the differences between low and high alumina catalysts, what is the effect on product yields and contamination resistance?

Bochow: We changed to high alumina catalyst in our unit approximately 18 months ago, and are very pleased with the results. At the time we were changing to high alumina catalyst we were also increasing our preheat temperature and coming up on the charge rate. Being familiar with cat cracking, you can see how the results are actually the product of changing several variables.

I would like to tell you five things that were noticed. First we think that high alumina catalyst has a very high activity maintenance. It seems that steam deactivates it much less than a low alumina catalyst, and we also had a decrease in catalyst loss. When we started using high alumina catalyst, our catalyst loss declined appreciably, then increased slowly and finally leveled off at a lower value than that experienced with low alumina catalyst. We believe this is caused by the low attrition rate on high alumina catalyst. It seems to be a little more resistant to attrition.

We also noticed that our air rate decreased even at the higher charge rates. It seems likely that the coke deposited on the high alumina catalyst had a tendency to

regenerate easier, and we found that we were burning more coke with fewer cubic feet of air. We tried to determine if a change in product distribution had taken place but could see no change. It probably happened because we were adding preheat at the time and increasing the charge rate. As far as I could tell, we ended up with a slightly greater amount of dry gas from the unit.

One change that we did notice was the CO_2 to CO ratio. Formerly, we were running at about 1.15 ratio and we dropped down below 1.0 (.95 to .98) and then as it leveled off we came up to around 1.0. That is the ratio we have today. This information is admittedly brief, but I think it covers the effect of the high alumina catalyst. I repeat again that we couldn't pick out any appreciable change in product distribution.

Jones

Jones: On this matter of high versus low alumina catalyst, there has been quite a debate in our organization over whether or not it is necessary to maintain the UOP weight activity (which is the means we use to measure the catalyst activity) at a somewhat higher level for high alumina in order to obtain the same results you would expect with low alumina catalyst at a lower activity level.

We now believe that we definitely have to carry the UOP weight activity about 4-6 units higher than we did with low alumina to do the same job. We still have less catalyst cost with high alumina under these conditions than with the former low alumina operation. It is extremely difficult to pin the magnitude of these factors down, because we've gone from about 5500 b/d of fresh feed to 8500 of fresh feed by raising preheat, putting in larger blowers, and other modifications.

Bochow: We have noticed a difference of even more than four units on this apparent catalyst activity. We are running about eight numbers higher than we did before. I have taken every opportunity to talk with the different representatives of catalyst manufacturers, and they all assure me that they are working up some correlations on this subject. It does appear that in order to obtain the same conversion, about eight numbers higher activity on the catalyst is required. We are maintaining around 38 UOP weight now, and we are running around 30 on low alumina catalyst. Our catalyst consumption rate is between 0.15 and 0.25 lb/bbl. I suppose it averages about 0.2 per lb/bbl, based on fresh feed.

? Controlling Regenerator Temperatures: We ran into the same CO_2 to CO ratio problems, but we also ran into slightly higher regenerator temperatures. Has anybody else who has made this change come up with a solution for the higher regenerator temperatures?

Park (Pure Oil Co.): We found a change in product distribution when we changed from low to high alumina catalyst. Not so much change in gasoline, but a very definite change in butylene and propylene distribution. We have a higher iso-butylene content, and not much change in normal butylene content, but an overall increase in C_4's. The propylenes, if anything, have gone down slightly. It just so happened that we did not make any other changes at that time, either in feed or in preheat or anything like that.

Wheeler

Wheeler: When you say you ran into the same thing, do you mean you ran into a lower CO_2 to CO ratio when you switched to the high alumina?

Park: That's right, we dropped the CO_2 to CO ratio from 1.1 to about 0.95.

Wheeler: But you had a higher regenerator temperature?

Park: We definitely got a higher regenerator temperature. I'll say this, we are burning slightly more coke, too. We are burning, oh, I guess our coke rate went up from about 22,000 to about 24,000 lb/hr.

Wheeler: Wouldn't that account for the higher regenerator temperature to a certain extent?

Park: Well, it would to a certain extent. Remember, this is a heat-balanced unit. It is an Orthoflow unit and, of course, your heat of cracking and vaporization has to balance the heat of burning of the coke.

I wonder if anyone has taken any steps to reduce the regenerator temperature short of perhaps reducing conversion, or something along that line?

Bochow: We certainly have that sort of problem. We are planning on increasing preheat temperatures even more because we are limited on catalyst circulation. We just recently installed a new preheater on the unit, and are having trouble removing the heat from the regenerator bed. We have talked about installing steam coils, that is, catalyst coolers, and we have the process design on it, but have not put them in the unit; however, it looks as if we may add them at a later date when we increase the capacity of our unit.

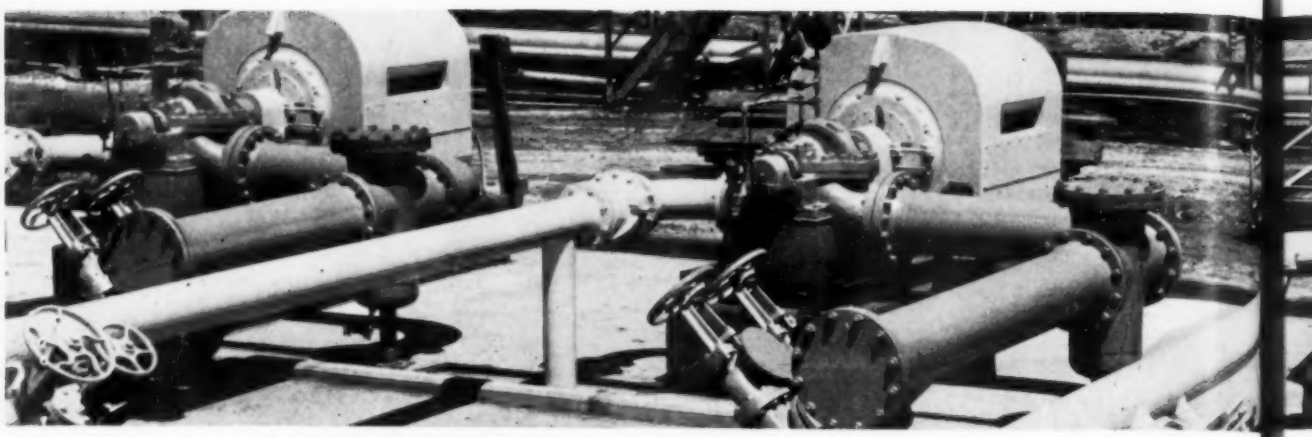
Park: What temperatures are you operating on now?

Bochow: Our dense phase runs around 1170, our dilute phase is running around 1190, and the stack temperature runs around 1220. We have gone through short periods after burning, where the temperature reached 1600+; however, we normally run at the temperatures just mentioned, or slightly lower.

For our size of unit, we are pushing it very hard in raising preheat temperature. We were circulating so much catalyst that our spent differential pressures were unstable. To reduce our catalyst circulation, we have increased preheat. It's the only way we know of to reduce catalyst circulation. Also, we are making some parts of the unit bigger.

In March more on . . .

Catalytic Cracking Problems



ELECTRICAL EQUIPMENT—how should it be specified; the answer lies in . . .

RP-500—What it Means and How To

GROUND RULES established by the American Petroleum Institute's Standard Recommended Practice 500—RP-500—have finally taken some of the guess work out of classifying electrical equipment.

RP-500 has significance for four major groups of processing people. It will mean:

- **To the operators:** 1—Possible physical changes in normal unit layouts to take advantage of classification provisions, 2—Reclassification of some areas within existing units, 3—Cheaper, but no less reliable, electrical systems.

- **To the engineer and maintenance man:** A method for systematically determining the extent of hazards for all refinery installations. No longer will ground rules change from one unit to the next within the same plant.

- **To the contractor.** His initial electrical design troubles won't be compounded with customer indecision and whimsical changes of mind.

- **To the plant owner:** If properly applied, the new rules will result in slightly lower initial costs for some elements, higher costs for other components of the electrical system. Overall, however, he should realize substantial savings in faster, cheaper designs, quicker on-stream times and faster, more decisive maintenance.

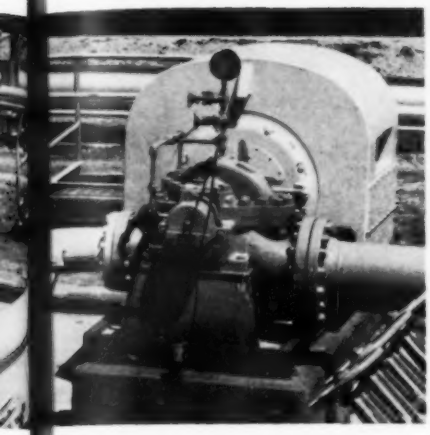
The National Electrical Code—the generally accepted authority on electrical installations—is clear and specific regarding the standards of equipment and installation practices in all areas once the location of such equipment is classified. Trouble in the past has been reaching agreement among all concerned—operators, designers, contractors—on which locations were hazardous and which non-hazardous. To confuse the picture further, the classification semi-hazardous (Class 2) has required considerable interpretation of such hazy terms as "normal" and "abnormal" operations. The need for an authoritative interpretation has been apparent for some time.

Most plants, lacking such a guide, have leaned to the conservative side and specified all equipment within the refinery explosion-proof. Later, in the interest of economy, many refineries began to arrange components of a unit to realize the economies of less expensive electrical equipment. The move to even more sensible application of electrical equipment has since been hampered by the lack of a definition of the limits of the hazardous areas.

Inconsistencies, such as insisting on explosion-proof equipment adjacent to open-flame furnaces, have been apparent to many. These inconsistencies may continue, but based on different arguments, because RP-500 now places the weight of informed authority behind the arguments of those who take a more realistic view of ignition hazards of electrical equipment.

Electrical engineers in the industry are receiving the new recommendations with mixed feelings, but with the general view that a great stride has been made in nailing down some nebulous conceptions. At the American Institute of Electrical Engineers Third Annual Electrical Conference of the Petroleum Industry, E. C. Benjamin, of M. W. Kellogg Company, said in a conference paper, "Acceptance and application of existing codes and adherence to the *recommendations of other authoritative bodies* offer avenues toward appreciable savings . . . without detracting from the adequacy of the electrical installation or eliminating any of its desirable features." (Italics by editor.)

Mr. C. M. Park, of the Mill Mutual Fire Prevention Bureau, in another conference paper entitled, "API Standard RP-500 in Relation to the National Electrical Code," states that "Publications such as API Standard RP-500,



ow To Use It

which are assumed to be based on industry experience, can very properly be used as guides by enforcing authorities in the classification of hazardous areas."

RP-500 is admittedly more conservative than the policies of a few refineries, but many other plants will stick to explosion-proof equipment even when no hazards are apparent. Proponents of this view point out that the higher first cost of such equipment is far outweighed by cheaper maintenance, more reliable service, and fewer breakdowns. For example, motors exposed to severe dust conditions, sometimes found in and around fluid catalytic cracking units, will require periodic cleaning and added maintenance to keep motor windings free of catalyst dust. Frequent cleaning, it is pointed out, will result in shorter insulation life, and much higher maintenance costs.

All engineers, however, are quick to point out that determination of the classification of locations within a refinery is a serious business, and should be undertaken only by those thoroughly familiar with the characteristics of electrical equipment and the areas in which the equipment operates. As RP-500 points out, the recommendation "is only a guide, and must be used with sound engineering judgment."

How to Use RP-500

- **For Class I locations:** Areas in which flammable vapors and liquids are processed, stored, loaded, unloaded, or otherwise handled.

  Step 1: The existence of a hazard is indicated by a "yes" answer to either of the following questions:

  a) Is the presence of flammable liquids or vapors having flash points less than 70°F likely?

  b) Are any flammable liquids or vapors having flash points under 200°F likely to be handled, processed or stored at temperatures above their flash points?

  Step 2: Assuming a "yes" answer from Step 1, the *degree* of hazard can be found:

- **For Division 1 locations:** Areas may be distinguished by a "yes" answer to any of the following questions:

  a) Is a hazardous gas or vapor concentration likely to exist in the air under normal operating conditions?

  b) Is a flammable atmospheric concentration likely to occur frequently because of maintenance, repairs, or leakage?

  c) Would a failure of process, storage, or other equipment be likely to cause an electrical system failure simultaneously with the release of flammable gas or liquid?

  d) Is the location of an area not freely ventilated, and one in which flammable liquids or vapors are stored in other than suitable closed containers or are handled or processed in other than a suitable, well-maintained piping system without valves, screwed or flanged fittings, and meters?

  e) Is the area below the surrounding elevation or grade such that flammable liquids or vapors may accumulate therein?

- **For Division 2 locations:** Areas may be distinguished by a "yes" answer to any one of the following questions:

  a) Is the location a freely ventilated one in which flammable liquids or vapors are processed or handled in closed systems (other than suitable, well-maintained piping systems consisting only of pipe, valves, fittings, and meters) from which they can escape only during abnormal operations such as accidental blowing of a gasket or rupture of a pipe, or are stored in other than suitable closed containers?

  b) Is the location adjacent to a Division 1 location, or can vapor be communicated to the location as through trenches, pipe, or ducts?

  c) If positive mechanical ventilation is used, could failure or abnormal operation of ventilating equipment permit atmospheric vapor mixtures to build up to hazardous concentrations?

  Non-hazardous locations are those which cannot be classified either Division 1 or Division 2.

  For physical limits of these locations, RP-500 gives specific recommendations.

- **Caution:** Further restrictions are imposed by the National Electrical Code according to the type of atmosphere in which the equipment is to operate. These are the common "Group" designations that have been established on the basis of the explosive characteristics of various atmospheric mixtures.

  For example: Equipment approved for operation in Group D atmospheres are most common in the refinery—these contain gasoline, hexane, naphtha, benzene, butane, propane, alcohol, acetone, benzol, lacquer-solvent vapors, or natural gas.

How to Give a Technical Talk

. . . black-tie or informal, here are tips to make it easier and better, by a teacher of technical men

By WILLIAM CULLEN BRYANT, II
Columbia University

YOU probably made a speech last year, even if you didn't think of it that way. Whether you slouched comfortably over a sheaf of notes, discussing your work with departmental associates, or stood hesitantly on the rostrum at a technical association meeting, you were a "public speaker." The audience, not the subject or the surroundings, defines the speech.

Think back. Did you talk *with*, or *at*, your audience? Were you *thinking* with them, or unwrapping thoughts already frozen into words and packaged for the eye rather than for the ear? Did you bow over your script and ignore your listeners, or did you face them, seize their attention, and hold it by the force and interest of your words? Were you, in short, COMMUNICATING—or did communication end at your desk when you wrote out the sentences to be recited aloud on a later occasion.

The day has gone when information could be circulated effectively throughout industry solely by means of clipboards, reports, graphs, articles, and technical papers read at professional meetings. These methods are inflexible and inadequate for the rapid give and take of information. Research and its application have become so closely linked today that the technical man can no longer find time to write out all his findings, or patience to pore over what others have written.

The most effective communication has always been live communication. It's brought to life when the communicator stands in the presence of his audience. To keep communication alive demands a high degree of interplay between them, in which senses, feelings and emotions play as important a part as mental processes and attitudes.

These facts of human relationship are being recognized in the training program operated by large industries and businesses. Public speaking instruction and practice (usually called "Effective Speaking") have taken their place alongside technical and administrative courses. Training officers are heeding these common complaints of management:

1—Speakers at technical meetings bore each other with dreary monologues

2—Rambling papers, read in a mumbling, incoherent manner, have to be cut off for lack of time before they come to the point

3—Significant findings are lost on audiences that would be eager to hear them, were technical people not subject to the same fatigues, irritations, and inattentions as all human audiences.

Think of the Listener First

Public speaking specialists agree that audience reaction should be uppermost in the mind of a speaker from the moment he starts to compose his speech. The motivations of the listener—not of the speaker—must be the main concern. Your words must draw the listener through what is called the "Motivated Sequence": he listens, realizes he needs the information, accepts the information, and clearly sees how it applies to his specific interests.

One authority* suggests that each of these steps should be aimed at a different kind of inertia in the listener: his first response is a yawn; his next, "Why bring that up?"; the third, "For instance?"; and the last, "So what?" But this is simply a striking way of driving home the importance of Motivated Sequence in the construction of a speech. Let's go over it in greater detail.

As the speaker, your first aim is to make effective contact with the audience—to build a bridge of interest that spans the dead space and anchors itself firmly in the attention of individual listeners. Words alone won't do this. Contact must be made also by look, gesture, facial animation—all genuine and arising in a natural way from your wish to talk with and not at the audience. This contact with

*Richard C. Borden, "Public Speaking—As Listeners Like It!" (Harper & Bros. 1935, New York).

Meet the Author

William Cullen Bryant II is chairman of the American Language Center for Foreign Students at Columbia University. He is also assistant professor of English at the university. For a number of years he has been teaching technical men at Esso Research and Engineering Co. how to speak more effectively.

Mr. Bryant received his B.S., A.M. and Ph.D. degrees from Columbia.

individual listeners will clarify your first blurred image of the audience as a monolithic mass and bring it into focus as a group of people with sympathetic interest.

Your second objective is to capture the interest of the audience for your subject. Plant in their minds the questions you are going to answer. Third, answer those questions. Finally, clearly show the significance of your answers.

What Does the Listener Want?

Naturally, to give a good speech, you should know your audience—how interested the people are, what they already know about the subject, how important it is to them in relation to other subjects, what aspects they want to know most about. For they, not you, are the best judges of what they want to know. As the speaker, you are so close to the material that you cannot make a rigidly limited selection of the points to deal with except by giving careful thought to the needs of your audience. While preparing the speech, place yourself figuratively in their seats and ask yourself the questions they will formulate as you speak.

Let's take a specific situation: the departmental or divisional progress report on research or design. Imagine yourself as a chemist or engineer who has been working for weeks or months on lubricants, detergents, or valves and piping. Now you must outline the results of your work in 20 or 30 minutes. Though overflowing with data and tentative conclusions, you must make a rigid selection of a few supporting facts arranged carefully around a central point. Your talk must be organized to achieve a single aim. Exclusion of extraneous matter, however interesting, must be ruthless.

But more is required. The unspoken questions of your listeners should be anticipated and answered *at the time they arise*. Otherwise you will be interrupted and made to backtrack in order to clarify a confusing statement, untangle a puzzling set of figures, or relocate a misplaced point. Or, your listeners may lose the thread of the talk in their impatience to ask questions lying unanswered in their minds. For there are two kinds of queries normally addressed to a technical speaker. One kind arises from confusion in the listener; the other is stimulated by his increasing interest. The first is bad, because it is both unproductive and time-consuming; the second is good, because it results from a successful report and leads to broader applications and wider benefits. The success of a speech often may be gaged by the extent to which it draws the second type of question rather than the first.

Build Around the Main Point

A good speech is controlled by a *single, specific aim*. It is built around some one major point. Everything else is subordinated to this point. More talks are ruined by speakers who straddle two related but different aims than by any other single cause. Usually this happens because the speaker hasn't sufficiently limited the scope of his subject to begin with. Standing so close to his findings and seeing in them several different points of significance, he hasn't taken enough time to settle on the most important one and to subordinate the others to it. His mind is full of interesting, but extraneous matter, and he resolves the confusion by throwing it all into the speech hopper, hoping that, somehow, it will take coherent shape. But if the speaker fails to give it shape, who will? Hardly his audience!

Composition doesn't occur on paper, but rather in the mind of the author. Therefore, if you start by selecting a specific aim and a single major point you've finished half the job before taking up your pencil. If you are wise, then, you will organize and outline the speech, selecting or rejecting supporting material by asking yourself whether it bears directly on your aim or not.

Pace your speech in this way: no more than a fifth of the time for introduction, or contact; a fifth for restatement in conclusion; the remaining three fifths will be barely enough in which to address the listeners' need to know and to satisfy it. In this part, you will gather all of your supporting material—illustrations, examples, figures— to drive home the central point. Now, if you haven't sufficiently limited the scope of your subject to start with, the introduction will probably be too long, your illustrations will run on and on, and finally you will find yourself frantically trying to condense the most important points and conclusions to keep within a time limit.

All too often the result of poor planning is a lopsided speech in which the speaker's aim is not made clear to his audience at any time. This can be avoided only by careful consideration of what can and should be covered in the time available. We recently witnessed a political campaign in which the unsuccessful candidate for the presidency seldom managed to complete a speech within his allotted television time. Under these circumstances, eloquence could not compensate for his failure to reconcile time with scope.

Composing the Speech

Make clear form and coherence your goals. These steps will help you along: once you have chosen your major

How to Prepare Your Talk

1. Pick a single, major point from all your ideas on your topic.
2. Estimate (with the breakdown given below) the ground you can cover in the available time.
3. Write an outline. Use only material that supports your main point. As you construct your argument, write a complete and separate statement for each major and secondary step.
4. Rehearse the whole speech out loud several times, preferably before other people. Don't memorize exact words; keep that flexible. Learn the order of the ideas. When the ideas and their order are fixed in your mind, put the outline in the wastebasket.
5. Make brief notes of essential facts, figures (rounded off) and quotes. Write large enough to read them at a glance, on cards of uniform size.

How to Pace Your Talk

Assume you have 20 minutes to talk:

1. First 4 minutes: Contact individual listeners by eye. Introduce your subject to them directly. Use anecdote, illustration, epigram, joke or drama, but be sure your opening furthers a specific aim of the speech.
2. Next 12 minutes: Take up the main point and supporting details. Phrase your thoughts to anticipate questions in the minds of the audience. Answer these questions as you raise them.
3. Final 4 minutes: Restate your conclusions in succinct, graphic terms—for emphasis. Make the clearest statement you can of their significance.

point and limited the scope, write an outline. In it, make a complete statement of each main and subsidiary step of your argument.

Then, rehearse the speech, aloud, until you no longer need the outline as a guide. Next, discard the outline to leave yourself free to modify words and phrases as the situation requires when you deliver the speech—but always keep the successive steps clearly in mind.

Finally, make a brief set of notes, typed or printed, and large enough to see at a glance. Put down the essential facts, figures (in round numbers), and exact quotations—don't overload your memory.

Perhaps this procedure goes against your inclinations or normal practice. "I always memorize my speeches," you may say. "That's the only way I can be sure of getting my facts straight." Or, you may object: "Unless I write it out in full and read it to an audience, I'm lost. I'm scared to death to get up on a platform without a manuscript." Yet, how familiar to most of us is the memorizer who has to stop and search his memory frantically for a particular phrase. And, who hasn't seen a reader turn two pages instead of one, or lose his place while taking an occasional peek at his audience tangling up his thoughts.

Neither can feel as secure on his feet as the speaker who doesn't need to lean on his script for support because he has organized his *thoughts* rather than his sentences. He, and he alone, is talking directly to his audience and thinking with them.

The minds of the memorizer and the reader are busy elsewhere. One is looking backward with his mind's eye toward the carefully constructed (and usually stiff and heavy) sentences etched hazily on his memory. The other is peering downward at similar ones printed on his page. Their words have an unconvincing ring to the hearer, for they are acting parts—they are trying to recreate the expressions, emphases, even gestures that were only half-articulated when the speeches were first composed.

What is it that makes the extemporaneous speech so forceful? Why are we impatient with the reader or reciter, yet excited and challenged by a good speaker who chooses his words as he delivers his thoughts? It's because we are experiencing the most direct form of communication, in which the whole personality of the speaker is tuned to his subject. His words, inflections, illustrations, gestures—all are the fresh expression of his matured thoughts and give them a graphic life.

The speaker who has planned his thought sequence with care, while leaving his choice of words free and flexible, has little need to worry about how he will perform on his feet. "Stage fright" shouldn't bother him at all. The causes of nervousness are almost exclusively false fears; in fact a healthy tension is essential if his words are to have buoyancy and vitality. The relaxed sprinter will never run a good race; the flatfooted tennis player is likely to be aced by the serves of his opponent.

Think about it. The usual reason for addressing a particular audience is that you are better informed and better qualified to talk on your subject than others in the audience. If you know their special interest in this subject, you need not feel inadequate to discuss it. And if you have rehearsed your speech properly—i.e., aloud, wholeheartedly and intelligently—the sound of your voice should reassure, not frighten, you.

Brevity Takes Time

It is a common but mistaken belief that almost anyone can make a short speech, but that a long one should be left to the expert. "How can I possibly talk for an hour?" the novice asks. His answer lies in a reported interview with Woodrow Wilson many years ago:

"How long does it take you to prepare a 10-minute speech," the veteran orator was asked.

"Two or three days," was his deliberate, considered reply.

"How about a half-hour?" the questioner continued.

"Six or eight hours," the president answered.

"Then," persisted the aspiring young public speaker, "how much time would you spend on a two-hour speech?" Mr. Wilson grinned, then snapped back:

"I'm ready now!"

Why Practice "Out Loud"?

If the thought of giving a speech an oral rehearsal occurs to the average technical speaker at all, his first impulse is probably to shut himself up in a soundproof room and orate to the echoing walls. He would never think of asking his colleagues to be an embryo audience—such an antic would make him look foolish, he thinks.

But skill in speechmaking needs to be acquired actively. It can scarcely be inherited or absorbed passively. What sport, art, or technical process would a sensible person try to perform without practice? Why do golfers swing their drivers by the hour? Does the would-be pianist content himself with reading a music score instead of practicing scales and arpeggios? Of course not. Then how can the public speaker expect to play upon the most exacting instrument of all, the human voice charged with meaning, unless he develops and perfects skill in its use?

If your office or laboratory isn't a good practice studio for reading and speaking aloud, your home is. The average man has a built-in audience at home well suited to helping him gain assurance on his feet—his family. Reading aloud to his children brings out the best of a man's vocal and dramatic powers; the father who thinks he can mouth the words of a fairy tale or an adventure story while his mind is busy elsewhere finds to his embarrassment that his audience has lost interest in it. And if you can put the speech or report into words both concrete enough and stimulating enough for your most exacting critic—your wife—you needn't worry over their probable effect on neighbors, colleagues, or bosses.

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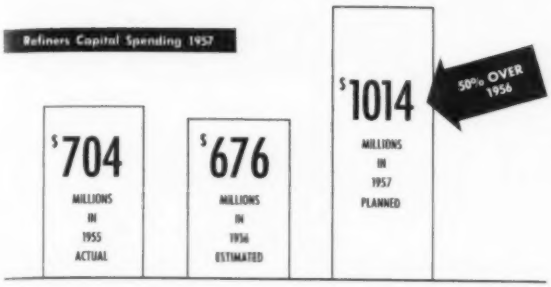

Spending Shifts To High Gear

Refiners plan 50% capital spending boost in 1957

SECOND largest increase in capital spending plans of all industry—exceeded only by nonferrous metals. That's the way the petroleum processing industry shapes up in the national picture for 1957, according to the latest annual preliminary survey of business' plans for capital spending by McGraw-Hill's dept. of economics.

Most of the essential points of this study are shown in the chart and tables. The increase in refining expenditures—from $676 million in 1956 to $1.014 billion this year—is by far the largest of any segment of the petroleum industry. Production, although with a smaller relative anticipated increase, has the largest overall investment plans—$4.179 billion for this year.

It is interesting to note that construction difficulties caused the 1956 expansion and modernization actual spending to fall far short of original goals. And, although most of this is now planned for 1957, it may prove impossible to meet present objectives before 1958.

Overall highlights of the complete survey showed six significant points:

1—Business capital expenditures are heading for stability at a high level. Most companies plan increases this year and will maintain this level in 1958. Although this is the biggest and longest capital spending boom on record, no downturn is yet in sight.

2—For 1957, business now plans to increase its spending 11%. This compares with a 21% increase a year ago. Plans for new plants and equipment for all business now total $40.2-billion.

3—For 1958, about two-thirds of the companies surveyed plan to maintain or increase spending over the 1957 level. Only 30% expect a decline.

4—The prices paid for new plants and equipment are expected to be about 6% higher, on the average, in 1957 than in 1956.

5—Some delay of 1956 expenditures until 1957 have occurred because of difficulties in construction and in delivery of equipment. In a few industries a part of the 1957 spending is being re-scheduled for 1958. Cash shortages—resulting from lower profits and tight credit conditions—have also been important causes in some cases. However, the main effect has been to stretch out plans for spending. Very few cancellations are reported.

6—Neither the elections nor the Suez crisis have had any significant effect on plans thus far. Only 3% of the companies surveyed said plans had been changed as a result of election returns. It seems entirely possible that new plans may eventually develop as a result of the foreign crisis.

Plans reported are preliminary, because many companies do not complete their budget reviews until later. However, past surveys of this same type have accurately shown trends.

Refining Near Top in Increase in Capital Spending Plans of Manufacturing Industries

(in Millions of Dollars)

Industry	1955 actual*	1956 estimated*	1957 planned	% change 1956-57
Nonferrous metals	293	589	937	+59
Petroleum refining	**704**	**676**	**1,014**	**+50**
Transportation equipment	274	467	691	+48
Iron and steel	879	1,257	1,659	+32
Chemicals	1,016	1,469	1,895	+29
Paper	518	808	978	+21
Other metalworking	729	850	1,013	+19
Electrical machinery	436	606	709	+17
ALL MANUFACTURING	9,440	12,647	14,434	+14
Machinery	809	1,067	1,169	+10
Food	505	581	628	+ 8
Beverages	213	217	220	+ 1
Rubber	150	193	193	0
Stone, clay and glass	498	688	663	− 4
Textiles	366	451	414	− 8
Miscellaneous manufacturing	922	1,009	876	−13
Autos, trucks, and parts	1,128	1,719	1,375	−20

*U. S. Dept. of Commerce, Securities & Exchange Commission, McGraw-Hill Dept. of Economics.

Refining Boost Is Biggest in Petroleum Industry

(in Millions of Dollars)

	1955 actual*	1956 estimated*	1957 planned	% change 1956-57
Refining	**704**	**676**	**1,014**	**+50**
Marketing	364	415	452	+ 9
Transportation[1]	249	321	350	+ 9
Production[2]	3,630	4,138	4,179	+ 1
Other	45	68	64	− 6
Total Petroleum industry	4,992	5,618	6,059	+ 8

*U. S. Dept of Commerce, Securities & Exchange Commission, McGraw-Hill Dept of Economics.
[1]Includes oil pipelines, does not include gas pipelines.
[2]Does not include bonus payments for leases.

How Business' Plans for 1957 Capital Spending Shape Up

(in Millions of Dollars)

Industry	1955 actual*	1956 estimated*	1957 planned	% change 1956-57
Electric & gas utilities[1]	4,309	4,817	6,018	+25
All manufacturing	9,440	12,647	14,434	+14
Transportation (non railroad) and communications	3,403	4,410	4,922	+12
ALL BUSINESS[2]	30,030	36,261	40,236	+11
Mining	318	423	461	+ 9
Petroleum industry	**4,992**	**5,618**	**6,059**	**+ 8**
Railroads	923	1,263	1,364	+ 8
Commercial	7,349	7,759	7,992	+ 3

*U. S. Dept of Commerce, Securities & Exchange Commission, McGraw-Hill Dept of Economics.
[1]Gas utilities based on survey by American Gas Assn.
[2]Petroleum refining, included under both manufacturing and petroleum industry, is counted only once in the ALL BUSINESS total.

Here are two articles on a new analytical technique. The first, below presents a useful new method of determining fuel oil stability, the second on page 94, describes the key chart used in this method.

Predict Fuel Oil Stabilities

. . . new optical method is fast, efficient

By W. H. ARMSTRONG, D. MILSOM
H. P. HEBERT, and A. R. RESCORLA
Cities Service Research & Development Co.
New York, N.Y.

THE PROBLEM of furnace oil stability has been given considerable attention by the refiner for the past several years, and new treatment processes and additives have been developed to improve storage stability.

As a result of the newer refinery processes for increasing gasoline yields, sufficient quantities of the more stable virgin gas oil will probably not be available for fuel oil blending in the near future. Nor has the extensive use of catalytic cracked stocks improved the stability of distillate fuel.

The formation of insoluble residue in some stored furnace oils has been attributed to the presence of certain sulfur compounds. In others, the nitrogen or diolefin contents have been reported as the contributing factors.

When first refined, the majority of furnace oils contain a negligible amount of insolubles. The insolubles result from deterioration during the storage period, which could be as long as 18 months from the time the oil is first blended until finally consumed.

Because these insolubles may result from the presence of sulfur, nitrogen, and diolefins, the refiner has to control the concentration of these compounds.

The ability to evaluate stabilities of fuel oils is as important as controlling the concentration of insolubles. However, before any practical method of evaluating stability can be developed, a definition of a stable fuel oil is needed.

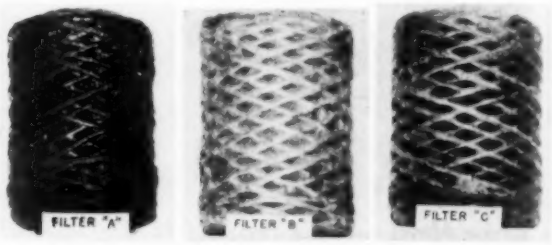

Fig. 1—**TYPICAL FILTERS** after average throughput of 1800 gal. **A**—More than 2 mg insolubles per 100 ml. **B**—a new filter shown for comparison. **C**—Less than 2 mg insolubles per 100 ml

What Is a Stable Fuel Oil

Fig. 1 shows three typical filters used in the authors' field tests. These filters were in service for one heating season. An average of 1800 gallons of fuel oil passed through each of them.

Filter "A" is coated with a considerable amount of sludge and would be most likely to cause trouble by plugging. Filter "C" was in service with an oil that contained less than 2 milligrams of insolubles per 100 milliliters, even after storage for 18 months. Filter "B" is unused and included for comparison purposes.

Conclusions from these field tests are that the fuel oil should contain not more than 2 mg of insolubles per 100 ml for a minimum of filter plugging.

An eighteen month wait in ambient storage is impractical for evaluating the stability of furnace oils, therefore, the need for accelerated laboratory test procedures becomes very evident.

The need for accelerated laboratory tests has been recognized in print. An accelerated laboratory test identified as an air oxidation test[1] was published by the authors in 1952. In this report it was demonstrated that a stable fuel oil is one having 2 mg or less of insolubles per 100 ml. of oil after 18 months storage. It was possible to complete this evaluation in 96 hours at 180°F using a filter pad discoloration technique. Correlations developed by the authors allowed the projection to ambient storage.

A more recent article,[2] employing a demerit rating as a measure of fuel stability, has been published. This rating depended on a filter pad discoloration, the pressure drop across the pad, and the sediment in 12 liters of oil expressed as milligrams.

From paper presented at a Group Session on Analytical Research during the 21st Midyear Meeting of the Div. of Refining, American Petroleum Institute, Montreal, Que., May 14, 1956.

The Problem Is Not New

THE STABILITY problem also confronted the industry some time ago, too—when catalytic gasoline was first blended into motor fuels. Although the gum content of motor fuels after storage at accelerated temperatures could be determined with little difficulty this information could not be easily translated into storage at ambient temperature without a suitable conversion chart.

E. L. Walters and coworkers[7] conducted an extensive investigation to develop such a correlation for gasolines. From the data obtained during this study it was established that if rate of gum formation is determined at several elevated temperatures, a curve for predicting the elapsed time to reach a given content can be prepared. This curve was found to be applicable to predicting the storage time on gasolines and compounds in this boiling range.

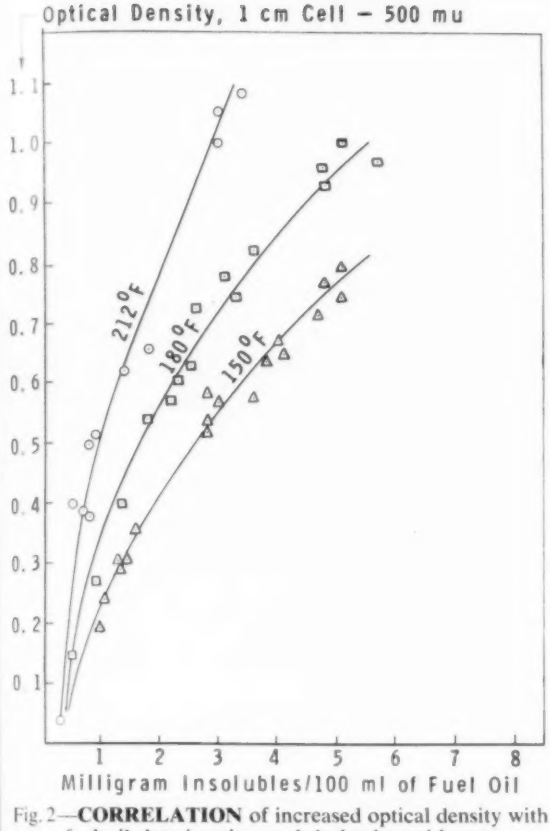

Fig. 2—**CORRELATION** of increased optical density with fuel oil deterioration and darkening with age

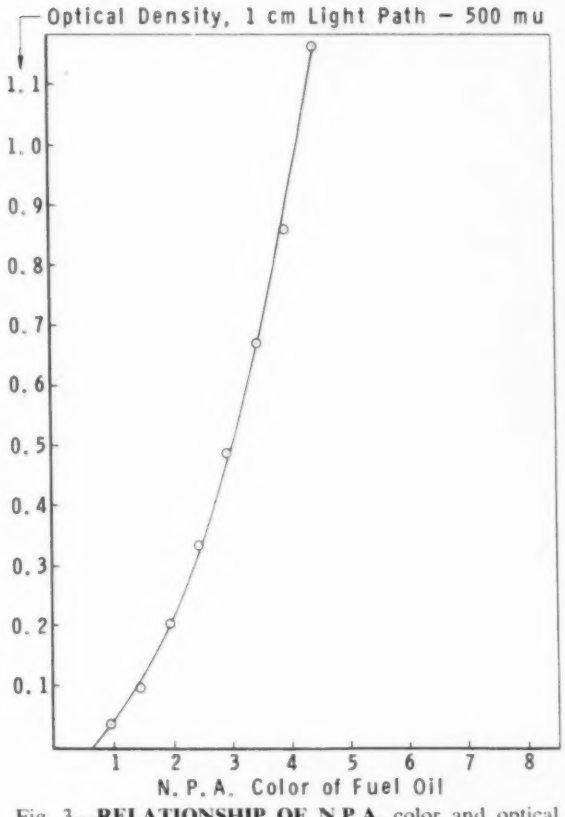

Fig. 3—**RELATIONSHIP OF N.P.A.** color and optical density as measured on a filtered oil

A maximum demerit rating showed a 300-mg sediment or the equivalent of 2.5 mg/100 ml.

Another article[3] published at the same time reported that an oil containing 25 ppm of insolubles would be unsuitable for use. This content would be equivalent to 2.0 mg per 100 ml. All of this published information suggests that others besides the authors consider an insoluble content of 2 mg as upper limit of tolerance for a stable oil.

Accurate measurement of insolubles can require a large sample, and be very time consuming. Several methods of measuring insolubles have been used by others to reduce time required to obtain insolubles such as pressure drop, rate of filtration (filterability) and pad discoloration.

The Naval Research Laboratory published a method[5] employing the principle of light scattering for the determination of diesel fuel stability. The increased intensity of light scattering was correlated with storage time.

That optical densities can be used to determine the insoluble content of fuel oils will be shown by data in this article. Also described is a method employing optical densities for evaluating fuel oil stability in terms of ambient temperature.

Developing the Procedure

In developing the procedure, the amount of insolubles retained on fritted glass filters of varying porosity was investigated.

As previously indicated, the determination of insolubles is very time consuming because of the fine porosity of the filter desired for retention of insolubles, and the large volume of sample needed for accuracy. In this investigation, a 350-ml sample was considered an adequate quantity for the desired accuracy.

A series of oxidized samples were passed through various porosity fritted glass filters having a 30-ml capacity and a disc of 30-mm diameter, as shown in Table 1. This small crucible was used primarily because it lends itself to the direct weighing of small amounts of insolubles.

Note that with one oil the filtration time for a medium filter was 15 min, while the same oil required 5 hr in a fine filter, and 16 hr in the ultrafine filter.

Approximately double the quantity of insolubles is retained by the fine filter compared to a medium filter. However, the ultrafine filter did not retain enough additional insolubles to warrant the increase in filtration time. Accordingly, in this investigation a fine filter was

Table 1—Effect of Filter Porosity on Insoluble Content Retained

Filter Type	Medium	Fine	Ultrafine
Average Pore Size, microns	15	4-5	1.2
Oxidized Fuel Oil Samples, insoluble residue, mg/100 ml			
A1	6.9	15.8	16.3
A2	1.8	3.7	3.9
A3	4.0	6.2	6.9
A4	2.5	4.0	4.1
A5	2.0	3.6	4.0

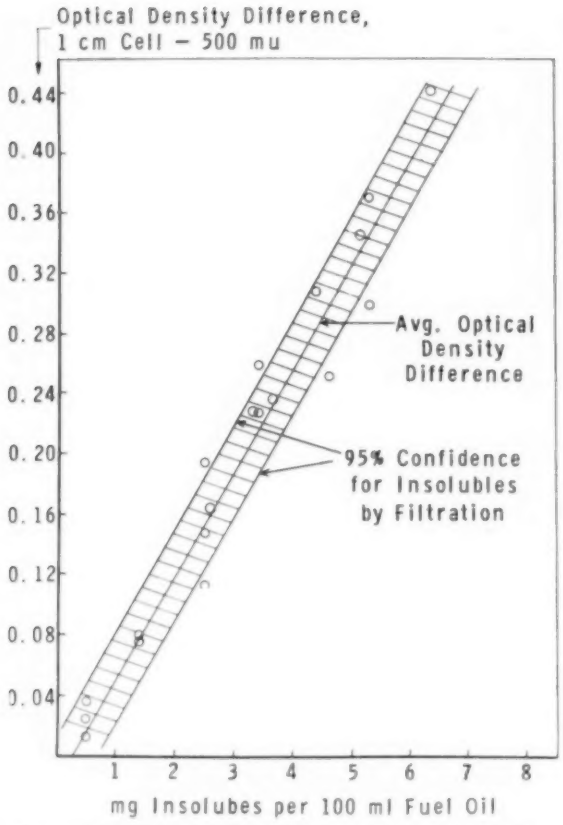

Fig. 4—**REPRODUCIBILITY** of optical and filtration methods for determining insolubles in fuel oil

used for all the determinations of insolubles by filtration.

Accuracy of the filtration method is reported in recent publications by the Petroleum Chemistry and Refining Branch of the Bureau of Mines.[4] It was reported in these publications that when all variables in sampling and analytical procedures are considered, the 95% confidence level for this determination was ±0.44 mg in 0-10 mg range, and ±1.52 in 10-30 mg range. Similar data have been obtained in the authors' laboratory.

A series of oils were stored at various temperatures and the insoluble contents determined by filtration. On the same samples the optical densities were determined with a Beckman Model "B" Spectrometer fitted with a photomultiplier attachment. A light path of one cm at 500 millimicrons (mu) was used for this determination.

Because the color of fuel oil darkens as the oil deteriorates, it was assumed that the increase in optical density would correlate with the deterioration. This assumption appeared to be valid for freshly refined oils where initial optical density was available. Fig. 2 confirms this.

It was noted that a relationship existed between optical density as measured on a filtered oil and the N.P.A. color. The effect of this relationship can be better appreciated from a study of Fig. 3.

Colors on a series of furnace oils from various crudes were determined by the two methods with resultant close agreement shown in Table 2. Petroleum technologists recognize that N.P.A. color can only be expressed to the nearest 0.25 number, with the determination being affected by both hue and intensity of the oil. By utilizing optical density measurements, which are based on intensity alone, it is possible to measure color deterioration more accurately, with the further advantage of being able to convert to corresponding N.P.A. colors.

If the data in Fig. 2 are closely observed, that the correlation between optical density and insolubles varies with storage temperature, further investigations indicated it was also affected by crude source.

The change in color indicates general degradation of the fuel oil, although it cannot be related quantitatively to the insoluble content. It is believed the formation of color bodies is a precursor to the formation of insolubles. It follows that the optical density and insoluble relationship was caused by the deflection of the light path by opaque bodies in the oil, presumably insolubles. Based on this assumption, it was considered possible to determine the insoluble content by determining the optical density of the oxidized fuel oil, and repeating the determination on a filtered sample of the same fuel.

To prove the above, a series of oils was oxidized and the insolubles determined by filtering 350 ml of fuel oil through a sintered glass crucible of fine porosity. Further, the optical densities were determined on the same oils before and after the filtration.

The results of this investigation, covering more than 200 independent determinations, are summarized in Table 3.

To compare reproducibility of the two methods for determining insolubles, the data are shown in Fig. 4, along with reproducibility for filtration.

It appears from the data that the optical density difference procedure is adequate for the determination of insolubles.

Temperature is very important in the storage of fuel

Table 2—Color Determination on Commercial Fuel Oil Samples

(Using the Optical Density Method)

Sample	Optical Density	Converted N.P.A. Color	Actual N.P.A. Color
1	0.188	2	2
2	0.072	1	1
3	0.292	2½	2½
4	0.568	3½ –	3½ –
5	0.177	2 –	2 –
6	0.322	2½	2½
7	0.895	4	4
8	0.356	2½	2½
9	0.086	1½	1½
10	0.137	2 –	2 –
11	0.161	2 –	2 –
12	0.215	2	2

Table 3—Insoluble Gum versus Difference in Optical Density

(For various oxidized fuel oils)

Range			Average Values for Each Range	
Insolubles mg/100 ml	Optical Density Diff.	No. of Determinations	Insolubles mg/100 ml	Optical Density Diff.
0.0-0.9	0.000-0.050	52	0.5	0.024
1.0-1.9	0.050-0.120	41	1.4	0.084
2.0-2.9	0.120-0.190	54	2.5	0.155
3.0-3.9	0.190-0.260	30	3.4	0.219
4.0-4.9	0.260-0.330	21	4.5	0.271
5.0-5.9	0.330-0.400	10	5.3	0.349
6.0-6.9	0.400-0.470	4	6.5	0.431

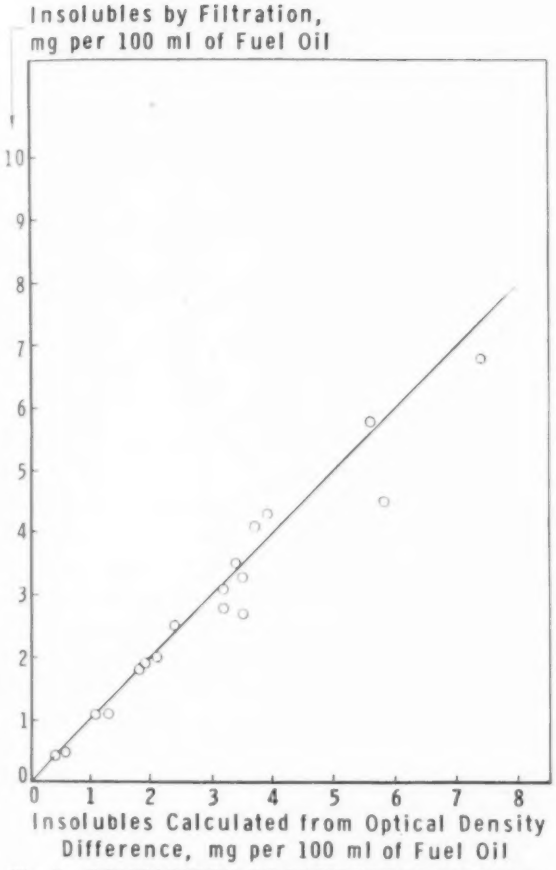

Fig. 5—**COMPARISON OF INSOLUBLES FOUND** by optical and filtration methods on commercial samples

oils. The oils are also sensitive to high temperatures frequently used in accelerated test procedures. Therefore, it was desirable to determine the effect of temperature on the optical density method for determining insolubles.

A series of fuel oils was oxidized at temperatures ranging from 88°F, or ambient, to 212°F, and the insolubles were determined by filtration as well as by optical density. The data in Table 4 show the temperature of oxidation to have little or no effect on the relationship between optical density and insolubles.

To further confirm the data previously presented, the insolubles, by filtration and optical density, were determined in a series of samples from various sources and at different stages of oxidation. These data are in Table 5 and further confirm a correlation between the two methods of determination. This correlation is emphasized to a beter advantage by Fig. 5.

With the correlation developed between optical density and insolubles by filtration, it remained to apply this correlation to a laboratory method for the determination of fuel oil stability.

It was previously indicated by definition in the authors' laboratory that a stable fuel oil is one having not more than 2 mg of insolubles per 100 ml of oil after 18 months storage at ambient temperature. To accelerate the fuel oil deterioration in the laboratory, temperatures above ambient are employed. The determination of the time to reach the 2-mg point at the higher temperatures

Table 4—Comparison of the Insoluble Content Found by Optical Density Difference and Filtration at Various Temperatures

Range of Insolubles mg/100 ml	Oxidation Temperature °F	Optical Density Diff.	Insoluble Content mg/100ml: Calc. from Optical Density Diff.	Insoluble Content mg/100ml: Filtration by Found
0.0-0.9	ambient	0.013	0.4	0.4
	110	0.032	0.7	0.4
	180	0.018	0.5	0.5
	212	0.044	0.8	0.7
1.0-1.9	ambient	0.102	1.7	1.2
	110	0.073	1.3	1.3
	150	0.071	1.3	1.7
	180	0.099	1.7	1.8
2.0-2.9	110	0.142	2.3	2.0
	150	0.153	2.5	2.4
	180	0.143	2.3	3.1
	212	0.149	2.4	3.4
3.0-3 9	150	0.219	3.4	3.3
	180	0.223	3.5	4.8
4.0-4.9	ambient	0.316	4.8	5.0
	110	0.291	4.5	4.3
	212	0.281	4.3	4.3

Table 5—Comparison of Insolubles Found by Optical Density and Filtration on Commercial Samples

Sample No.	Oxidation Temperature °F	Optical Density Diff.	Insolubles mg/100 ml: Calc. from Optical Density Diff.	Insolubles mg/100 ml: Found by Filtration	Insolubles mg/100 ml: Diff. Between Methods
1	212	0.481	7.4	6.8	0.6
	180	0.253	3.9	4.3	—0.4
	150	0.013	0.4	0.4	0.0
2	212	0.377	5.8	4.5	1.3
	180	0.228	3.5	2.7	0.8
	150	0.226	3.4	3.5	—0.1
3	212	0.025	0.6	0.5	0.1
	180	0.367	5.6	5.8	—0.2
	150	0.207	3.2	3.1	0.1
4	212	0.107	1.8	1.8	0.0
	180	0.114	1.9	1.9	0.0
	150	0.228	3.5	3.3	0.2
5	212	0.061	1.1	1.1	0.0
	180	0.124	2.1	2.0	0.1
	150	0.207	3.2	2.8	0.4
6	212	0.072	1.3	1.1	0.2
	180	0.266	3.7	4.1	—0.4
	150	0.149	2.4	2.5	—0.1

can be obtained in the laboratory without difficulty, but a correlation is required to convert these values to ambient temperatures.

A rather extensive investigation has been conducted in the authors' laboratory to develop a time-temperature correlation so that the data obtained at accelerated temperatures in the laboratory could be converted to equivalent storage at ambient temperatures. By oxidizing numerous fuel oils over a temperature range 80-212°F and determining the insoluble contents at different storage periods, it was possible to develop a correlation between relative stability expressed as time to reach a certain insoluble content and temperature.

The results of this investigation have been used in developing the conversion curve shown in Fig. 6. The detailed data used in the development of this curve are now being prepared for publication.

If the time of oxidation at 180°F to reach 2 mg in-

■ *Fuel Oil Stability Test—Optical Method*

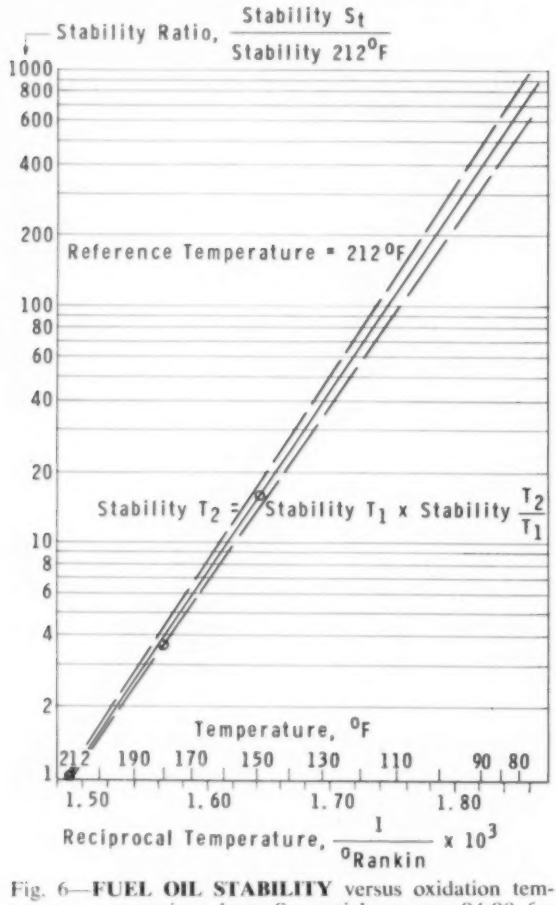

Fig. 6—**FUEL OIL STABILITY** versus oxidation temperature conversion chart. See article on pp. 94-98 for development of this graph

solubles per 100 ml is 56 hr, it will be observed from the same calculation shown in Fig. 6 that the stability at 88°F would be 42 weeks. To obtain the factor for converting the 56-hr stability at 180°F to 88°F, the stability ratio factor for 180°F referred to 212°F was first determined as 3.8. The corresponding value at 88°F was found to be 479. The ratio of these numbers was used as a multiplying factor, and employed in determining the value of 42 weeks at 88°F.

A method to confirm the results of this conversion, similar to that previously described in the literature,[1] was used—except that drums were stored under controlled conditions. Hereafter, in this article the storage will be referred to as drum storage.

Fuel Oil Stability Evaluation Procedure

By means of optical density procedure it is possible to determine the insoluble content in a relatively short period of time (one half hr) on a 20 ml of sample and with the same reproducibility that can be obtained by filtration. The oxidation time to reach this insoluble content can be projected to equivalent time of ambient storage by means of a correlation, thus translating the storage stability results into a language easily understood by all.

Here is the procedure followed in the authors' lab:

Table 6—Stability Evaluation of Commercial Oil Modified Aid Oxidation Procedure at 180°F

Sample No.	Hrs. of Oxidation	Optical Density: Before Filtration	Optical Density: After Filtration	Optical Density: Diff.	Insolubles mg/100 ml: By Filtration, (Grav.)	Insolubles mg/100 ml: Calc. from Optical Density Diff.
A	0	0.913	0.895	0.018	0.3	0.5
	12	1.322	1.211	0.111	1.2	1.8
	24	1.737	1.559	0.178	2.1	2.8
	32	2.080	1.901	0.179	2.7	2.8
	48	2.707	2.397	0.310	6.6	4.8
B	0	0.233	0.207	0.016	0.5	0.4
	24	0.737	0.602	0.135	1.0	2.2
	48	0.737	0.638	0.099	1.2	1.7
	72	1.558	1.364	0.194	2.7	3.0
	80	2.332	2.066	0.266	3.7	4.1
C	0	0.149	0.137	0.012	0.4	0.4
	96	0.538	0.509	0.029	0.7	0.7
	168	0.767	0.585	0.182	2.7	2.9
	216	0.954	0.699	0.255	3.3	3.9

Purpose—To determine stability of distillate fuels by accelerated oxidation at elevated temperatures.

Equipment

1—Suitable oil bath with temperature controlled at 180°F ±0.1°F.

2—50 x 400 mm pyrex glass oxidation tubes fitted with condensers identical with those required for Steam Turbine Oil Test ASTM D943-54.

3—Pyrex spargers, Corning No. 39533-12EC.

4—Spectrometer similar to Beckman Model B or equivalent for measuring optical densities at 500 mu.

5—Fritted glass crucibles—fine porosity.

Procedure—After filtration through a coarse qualitative filter paper for removal of extraneous material, the fuel oil under test (350 ml) is placed in the oxidation tube fitted with condenser and sparger for delivery of air to the sample.

The tube and contents are placed in a constant temperature bath at 180°F, and filtered dry air measured with a flowmeter is passed through the sample at the rate of 5 liters/hr. Air is also passed through the condenser at a suitable rate to prevent loss of volatile materials.

A series of tubes for each oil is placed in the bath to allow the preparation of a curve of insolubles versus time of oxidation. A typical series of points would include two values near the 2-mg point, and an equal number above (3-5 mg) and below this value.

At the selected time, the tube and contents are removed from the bath and allowed to cool for at least four hours. After cooling, the sample is thoroughly shaken and sufficient sample for an optical density determination is filtered through a fritted glass crucible of fine porosity. At the same time a portion of unfiltered sample is well mixed and placed in a matching optical density cell.

Before making the optical density determination the spectrometer is zeroed as recommended, and the 100% transmittance point obtained using n-heptane as the reference standard at 500 mu. Where the spectrometer does not have sufficient sensitivity, it is suggested the filtered oil be used as the standard.

To eliminate differences that may exist between instruments, a calibration curve for each instrument should be developed. This is done by determining the optical

Table 7—Conversion of Air Oxidation Results to Drum Storage for Commercial Samples

Sample No.	A.O.M.* Inflection, hours	Predicted Ambient Drum Storage at 88°F, weeks
A	17	13
B	56	42
C	151	113

*A.O.M. = Air Oxidation Method

density differences and insolubles on a series of oils over the desired range.

All sample cells should be matched, and maintained scrupulously clean inside and outside. Water haze in all samples should be removed by blowing with filtered dry air.

Calculations—The optical density differences are calculated for each sample from the determined value before and after filtration. This difference is converted to corresponding insolubles from the calibration curve. Once the insolubles are determined on a series of samples, a curve is constructed and the time to reach the 2-mg point determined.

By use of the time-temperature curve, Fig. 6, it is possible by the procedure previously explained to convert this time to ambient storage at any selected temperature. Details on the development of Fig. 6 are in the article on pp. 94-98 of this issue.

Normally, this time of oxidation in hours at 180°F is converted to weeks of drum storage at 88°F by multiplying the air oxidation inflection time in hours by a factor of 0.75. This value can be reproduced to within ±2 weeks of drum storage.

Typical Results—The optical density difference method has been used in the authors' laboratory for the evaluation of blending stocks as well as finished blends. It has also been rather widely used for determination of inhibitor requirements on refinery blends with good success.

To demonstrate how the method can be effectively used to determine the stability on finished blends, the results of an evaluation on three commercial oils from different crude source have been presented in Table 6. This table shows the data obtained on a series of four independent determinations for insolubles at different times of oxidation for each oil. The insoluble contents were determined by filtration through a fine porosity filter by accepted gravimetric techniques. These insoluble values are in good agreement with the values calculated from optical density difference. Because the formation of insolubles is not a linear function, the time to reach the 2 milligram per 100 ml insoluble point cannot be determined by arithmetic interpolation, but can easily be obtained by graphic interpolation (Fig. 7).

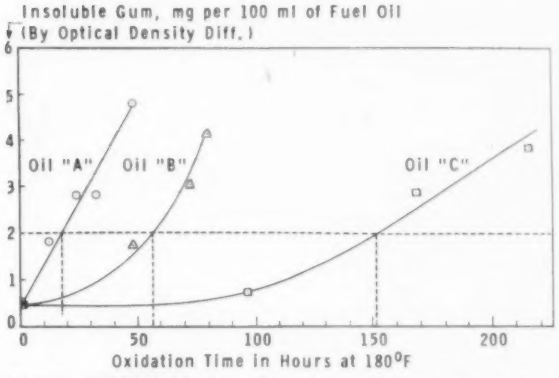

Fig. 7—**RESULTS** of modified air oxidation test on commercial fuel oils at 180°F oxidation temperature

These graphs show that the insolubles in oil "A" increase rather rapidly with time of oxidation and reach the 2-mg point in 17 hr at 180°F. Oil "B" shows more resistance to oxidation and the 2-mg point is 56 hr under the same conditions. The curve for oil "C" is characteristic for an oil having good stability and the rate of increase in insolubles is much lower than that exhibited by oil "A." The time required for this oil to reach the 2-mg point is 151 hr at this accelerated temperature.

The air oxidation time in hours can be converted to corresponding weeks of drum storage at 88°F by using the factor previously mentioned. This information has been recorded in Table 7 where it will be observed oil "A" could only be expected to store for a period less than 3 months before it would cause plugging difficulties, while oil "C" could have been stored for a 2 year period without becoming unstable.

References

(1) Rescorla, A. R., J. H. Cromwell, and Daniel Milsom, "Laboratory Evaluation of Fuel Oil Stability," *Analytical Chemistry*, 24, 1959-64 (1952).

(2) Konrad, W. A., T. S. Tutwiler, and N. L. Shipley, "New Fast Test Method for Distillate Storage Stability," PETROLEUM PROCESSING, Sept. 1956, pp. 145-9.

(3) Dimpfl, L. H., J. E. Goodrich and R. A. Stayner, "The Evaluation of Distillate Fuel Oil Additives," presented before Div. of Petroleum Chemistry, 128th Meeting, American Chemical Society, Minneapolis, Minn., Sept., 1955.

(4) U. S. Bureau of Mines, Petroleum Experiment Station, Bartlesville, Okla., "WPRA-Bureau of Mines Cooperative Distillate Fuel Storage Stability Program," Progress Report No. 6, Feb., 1955.

(5) Johnson, J. E., A. J. Chiantella and H. W. Cahart, "Application of Light Scattering to Diesel Fuel Stability Problems," *Industrial & Engineering Chemistry*, 47, 1226 June, 1955.

The Authors Sum Up This Section

We've shown here that the optical density procedure described can determine colors as well as insoluble content. Optical density can determine fuel oil insoluble content in about 30 minutes, compared to gravimetric methods requiring as many as 6 or 8 hours.

A method of evaluating stability of fuel oils at accelerated temperatures of 180°F has been developed that provides results in hours, which can be translated with conversion factors into weeks of drum storage at ambient temperature.

Turn page for background of temperature-time curve →

Heart of new fuel oil stability test is . . .

Time-Temperature Chart

By DANIEL MILSOM and A. R. RESCORLA

Cities Service Research & Development Co.
New York, N.Y.

FUEL OIL storage presents problems to the refiner. From the time the fuel oil is prepared in the refinery until it is actually used a period of 18 months can pass, and this material may be subjected to temperatures as high as 110°F.

The fuel oil should be evaluated at some elevated temperature in the laboratory, and the results converted into corresponding storage periods at average climatic temperatures, if the refiner is to prepare a fuel oil of good storage stability.

The authors have published a previous paper[3] describing a laboratory procedure for evaluating stability, and the 2-mg. per 100-ml. insoluble point was selected as the maximum insolubles that should be tolerated in a stable oil. The other papers[1,2] have reported that oils containing this amount of insolubles are undesirable.

As previously indicated, the determination of insolubles by accelerated laboratory test procedures without suitable methods of converting these results to average climatic temperatures are of little practical value to the refiner. In the article[3] mentioned above the authors describe a procedure for converting the pad discoloration results to ambient temperature. This article will present additional data on a method for determining storage times over a wide temperature range from the values obtained at elevated temperatures.

Theoretical Considerations

The complex composition of No. 2 fuel oil precludes the possibility that the reactions resulting from or associated with storage can be treated in any simplified manner. To correlate the insolubles with nitrogen content, the various types and quantities of sulfur compounds, or diolefins will be only partially correct. Not only are these compounds responsible for the insoluble formation, but the form in which these compounds are present in each fuel oil is even more important.

In view of the complexity it appears that the original cause of insoluble formation cannot be easily correlated to composition. However, the rate at which the insolubles do form is important, and it is desirable to predict this rate of formation at different temperatures.

From Fig. 1, it will be observed all fuel oils do not follow the same pattern of degradation. However, it is of interest to note that in all of the fuel oils the insoluble formation accelerates near the two milligram point. Similar data on insoluble formation in gasoline have been reported by Walters.[7]

To study temperature effect on the rate of insoluble formation in fuel oils, a series of fuel oils were stored at different temperatures. Data on a typical fuel oil stored at four different temperatures has been included in Fig. 2 where the insoluble content is compared with time of storage. In a previous article[3] the authors have established that an insoluble content of 2 milligrams per 100 milliliters will cause filter discoloration, and make the fuel oil unstable. This value has been confirmed by others.[1,2]

If the storage time to reach the 2 milligram point at the various temperatures is compared, it will be noted a semi-logarithmic relationship exists between these storage periods, and reciprocal of temperature.

It has been established in the authors laboratories that the time of storage at 110°F should be multiplied by a factor of 4.2 to determine equivalent storage time at ambient temperature (average 85°F). A similar value has been reported in the literature by other investigators[4,5] and has been generally accepted as a reasonable conversion factor. Based on the data reported in Fig. 2, the storage time to reach the 2 milligram point at 212°F should be multiplied by a factor in the neighborhood of 600 to determine storage time at 85°F.

When it is considered that the time to reach the 2 milligram point at accelerated temperatures must be multiplied by such large factors to convert to equivalent storage at ambient temperature, the importance of accurately determining the 2 milligram point can be appreciated.

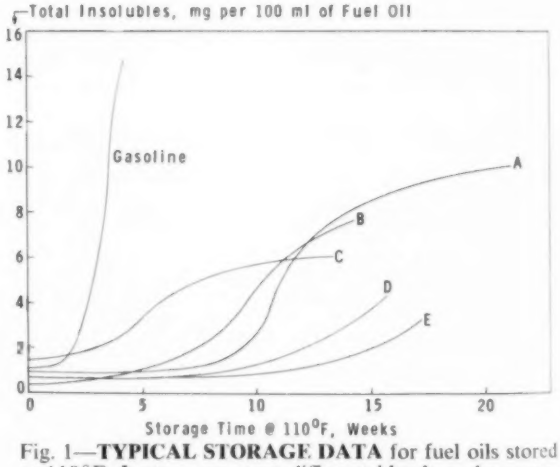

Fig. 1—**TYPICAL STORAGE DATA** for fuel oils stored at 110°F. Letters represent different blends and sources.

According to present analytical methods the accuracy for determining 2 milligram insolubles is ±0.44 milligrams at the 95% confidence level. Rather than selecting one insoluble content for determining the time of storage at accelerated temperatures, a minimum of two values below and above the 2 milligram value are used. The 2 milligram point can be accurately determined with a graph including these four points.

From paper presented at the American Chemical Society's 130th National Meeting, Atlantic City, N.J., Sept. 16-21, 1956.

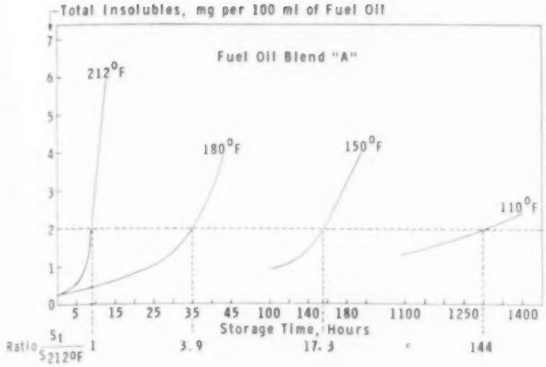
Total Insolubles, mg per 100 ml of Fuel Oil
Fuel Oil Blend "A"
212°F
180°F
150°F
110°F
0 1 2 3 4 5 6 7
5 15 25 35 45 100 140 180 1100 1250 1400
Storage Time, Hours
Ratio $\frac{S_t}{S_{212°F}}$ 1 3.9 17.3 144

Fig. 2—**OVEN STORAGE OF NO. 2 FUEL OIL** at various temperatures—based on Blend A, discussed in text.

The preceding article presents a method for determining the insolubles in fuel oil by means of optical density measurements. Essentially the procedure consists of measuring the optical density of a fuel oil sample before and after filtration through a fine porosity filter.

Experimental Investigation

The main objective of the experimental work was to collect sufficient data on a series of typical fuel oils to develop a correlation between temperature and storage time. To accomplish this objective the fuel oils were stored at four temperatures, 212°F, 180°F, 150°F and 110°F.

In all cases the temperatures of the baths and ovens were maintained at $\pm 0.\frac{1}{2}$°F, and were periodically checked with a standard reference thermometer. Because a difference of 1°F could introduce an error of as much as 6%, the close temperature control was considered essential.

At 212°F and 180°F, three hundred and fifty milliliter samples were stored in a constant temperature bath, and the procedure described in the article preceding this one was employed for evaluating the storage time versus insoluble relationship. The optical density difference measurements were also used to determine the total insolubles.

Boston round bottles containing 300 milliliters of sample and stoppered to prevent evaporation were stored at 150°F, and 110°F. Each day the bottles were removed from the oven, and air introduced to simulate storage conditions. Periodically one of the bottles was removed from the oven and the insolubles determined.

For purposes of illustrating the type of data obtained, two curves (Figs. 3 and 4) have been included in this paper. In Fig. 3, the optical density difference as well as the insolubles of oil "B" is compared with storage time for four different storage temperatures. The ratio factors for 110°F, 180°F, 150°F compared to 212°F are also indicated at the 2 milligram insoluble point.

It will be observed that the data included on oil "B" in Fig. 3 is in good agreement with those obtained on oil "C" (Fig. 4).

A series of seventeen oils blended from various stocks, with and without inhibitors, were selected for Table 1. It was not feasible to include the graphs of insolubles versus time of storage for each oil in this paper, and for this reason only the time of storage to reach the 2 milligram point at each temperature was listed.

The ratios comparing the time of storage with that at 212°F have also been calculated, and included. Similar data on a series of eight competitive fuels have also been collected, and recorded in Table 2. It will be observed that the ratios calculated for both series of oils are in good agreement.

To develop a correlation between storage time to the 2 milligram point and storage temperature, it was decided to plot time as a logarithmic function on the vertical axis, and reciprocal of absolute temperature in degrees Rankin on the horizontal axis. This provided a series of nearly parallel lines for each oil sample, as shown in Fig. 5. The curves in this figure were prepared from data presented in Table 1. Similar data on competitive oils shown in Table 2 have also been graphically presented in Fig. 6, and again a series of nearly parallel lines resulted.

The parallel lines obtained in both curves can be expressed mathematically by the Arrhenius type of equations:

$$(d\ln k)/dT = E/RT^2 \qquad (1)$$

$$\ln(k_1/k_2) = E/R\left(\frac{1}{T_2} - \frac{1}{T_1}\right) \qquad (2)$$

where:

E=Activation energy per gm mol of a material

k_1=Reaction rate at the absolute temperature T_1

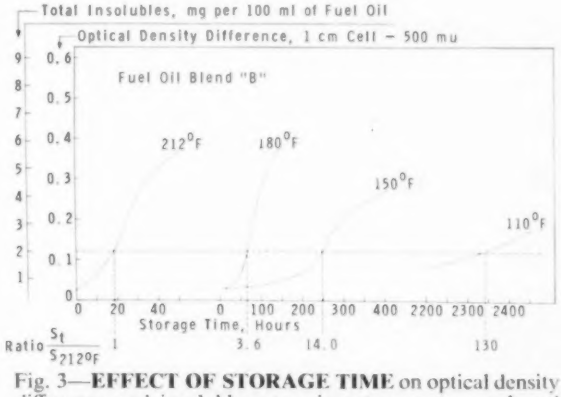
Total Insolubles, mg per 100 ml of Fuel Oil
Optical Density Difference, 1 cm Cell – 500 mu
Fuel Oil Blend "B"
212°F
180°F
150°F
110°F
0 1 2 3 4 5 6 7 8 9
0 0.1 0.2 0.3 0.4 0.5 0.6
0 20 40 0 100 200 300 400 2200 2300 2400
Storage Time, Hours
Ratio $\frac{S_t}{S_{212°F}}$ 1 3.6 14.0 130

Fig. 3—**EFFECT OF STORAGE TIME** on optical density difference and insolubles at various temperatures—based on Blend B, discussed in text.

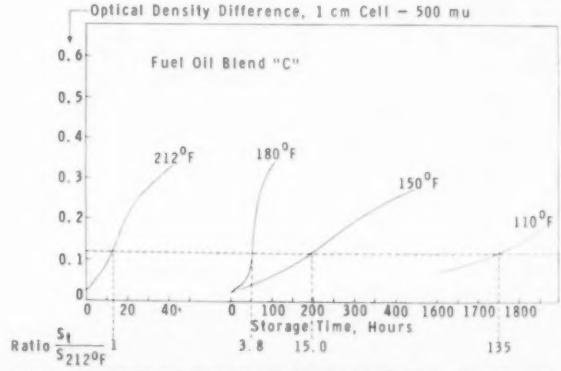
Optical Density Difference, 1 cm Cell – 500 mu
Fuel Oil Blend "C"
212°F
180°F
150°F
110°F
0 0.1 0.2 0.3 0.4 0.5 0.6
0 20 40 0 100 200 300 400 1600 1700 1800
Storage Time, Hours
Ratio $\frac{S_t}{S_{212°F}}$ 1 3.8 15.0 135

Fig. 4—**EFFECT OF STORAGE TIME** on optical density difference at various temperatures—based on Blend C, discussed in text.

■ *Fuel Oil Stability Test—Temperature Conversion*

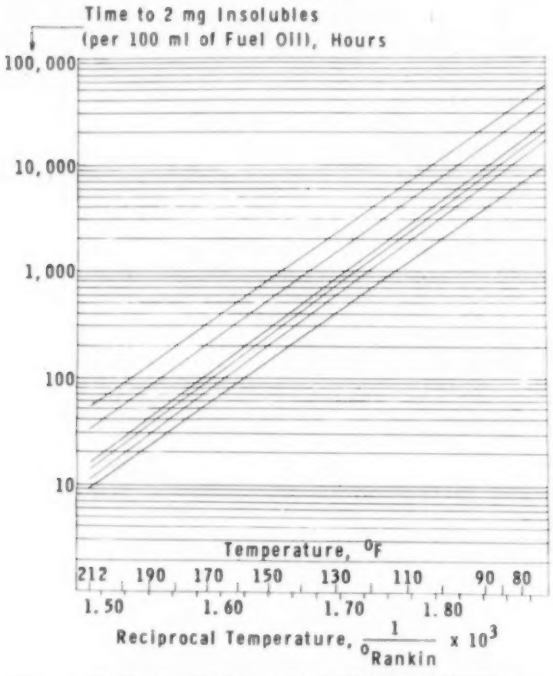

Fig. 5—**TIME-TEMPERATURE RELATIONSHIP** on a series of fuels, uninhibited and inhibited with additives.

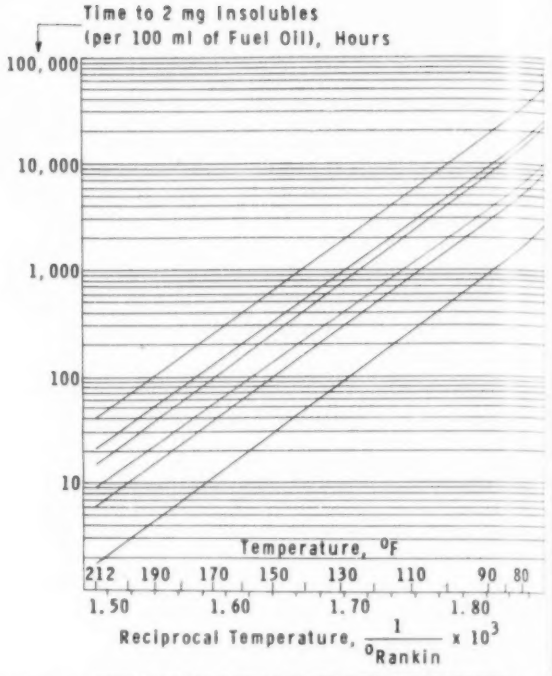

Fig. 6—**TIME-TEMPERATURE RELATIONSHIP** on a series of fuels from different crude sources.

k_2=Reaction rate at the absolute temperature T_2

R=Gas Constant

If it can be assumed that T_θ is a reference temperature with a reaction rate of unity, and that $S=1/K$ (or time required to reach a reference level of oxidation stability), then:

$$\ln(S/S_\theta)=E/R\ (1/T-1/T_\theta) \quad \ldots\ldots (3)$$

where:

S_θ=Stability at reference temperature (212°F)

T_θ=Reference temperature of 212°F

S=Stability at any temperature, T

then $E/R=B$ is a constant depending upon the oil and $A=B/T_\theta$ is a constant for a given oil, giving:

$$\log(S/S_\theta)=B/T-A \quad \ldots\ldots (4)$$

The stability ratio, in this investigation, is expressed by Equation (4), and the reference temperature is 212°F.

Meet the Authors of These Two Articles

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Mr. W. H. Armstrong is Associate Research Chemist at the Lake Charles, La. laboratory of the Cities Service Research & Development Co. He was born in Oakdale, La., and received his B.S. degree in Chemistry from Louisiana Polytechnic Institute in 1949. Mr. Armstrong joined Cities Service Refining Corp. at Lake Charles, La., after graduation, and was assigned to the Special Problems Section of the refinery laboratory at that time.

Mr. Daniel Milsom is Assistant Chief Chemist at the Lake Charles, La. laboratory of Cities Service Refining Corp., assigned to Cities Service Research Co. projects. He was born in Allport, Pa., receiving his B.S. from Pennsylvania State College. Mr. Milsom was employed by Gulf Research & Development Co. at Harmarville, Pa., from 1938 to 1941, joining Cities Service at Lake Charles in 1943.

Mr. Hugh P. Hebert is Associate Research Engineer at the Lake Charles, La., laboratory of Cities Service Research & Development Co. He was born in Jeanerette, La., receiving his B.S. in Chemical Engineering from Southwestern Louisiana Institute in 1952, at which time he joined Cities Service Research.

Mr. Arthur R. Rescorla is Administrative Assistant, Cities Service Research & Development Co., a position he has held since 1948. He was born in Plymouth, Pa., receiving a B.S. and an M.S. from Pennsylvania State College. From 1932-1937, Mr. Rescorla was Research Assistant at Pennsylvania State, and from 1937-1943 he was Head of the Analytical Laboratory for Gulf Research & Development Co. Mr. Rescorla joined Cities Service Refining Corp. in 1943, serving as Chief Chemist until receiving his present position in 1948..

Table 1—Storage Time vs. Temperature for Fuel Oil Blends

Fuel Oil Blends	Stg. time, hrs. to 2 mg/100 ml Insolubles				Ratios $\frac{S_T}{S_{212°F}}$			
	212°F	180°F	150°F	110°F	212°F	180°F	150°F	110°F
D	9.0	35	156	1275	1	3.9	17.3	142
E	11.0	40	160	1180	1	3.6	14.6	107
H	7.0	25	112	900	1	3.6	16.0	129
N	15.0	55	245	...	1	3.7	16.3	...
S	17.0	65	285	...	1	3.8	16.7	...
W	9.5	35	138	...	1	3.7	14.5	...
4B	5.0	18	...	744	1	3.6	...	149
Fuel Oil Blends With Additives								
F	12.0	45	205	1875	1	3.7	17.1	156
G	60.0	192	925	...	1	3.2	15.4	...
M	18.0	69	285	...	1	3.8	15.8	...
O	32.0	128	518	...	1	4.0	16.2	...
P	15.0	56	258	...	1	3.7	17.2	...
R	41.0	138	615	...	1	3.4	15.0	...
T	53.0	168	810	...	1	3.2	15.3	...
X	13.5	51	210	...	1	3.7	15.6	...
Z	36.5	133	567	...	1	3.6	15.5	...
O2	13.0	48	...	1728	1	3.7	...	133
Average Ratio, $\frac{S_T}{S_{212°F}}$					1	3.6	15.9	136

Table 2—Storage Time vs. Temperature for Competitive Fuels

Oil No.	Source	Storage time, hours to 2 mg/100 ml Insolubles			Ratios $\frac{S_T}{S_{212°F}}$		
		212°F	180°F	150°F	212°F	180°F	150°F
1	East Coast	1.8	7	29	1	3.9	16.1
2	East Coast	9.0	34	143	1	3.8	15.8
3	East Coast	16.0	59	258	1	3.7	16.1
4	East Coast	16.0	58	220	1	3.6	13.8
5	Mid West	6.0	19	110	1	3.2	18.3
6	Mid West	21.0	68	310	1	3.2	14.8
7	Mid West	41.0	138	650	1	3.5	15.9
8	Mid West	13.0	50	195	1	3.8	15.0
Average Ratio $\frac{S_T}{S_{212°F}}$					1	3.6	15.7

Table 3—Comparison of Drum Storage with Calculated Storage Results

Sample No.	Actual Drum Stg. 100°F, Wks.	Laboratory Evaluation Hrs. Stg. at 180°F	Predicted Stg. at 100°F, Wks.	Diff. of Actual and Predicted
1	7	24	9	2
2	15	48	17	2
3	21	60	22	1
4	8	24	9	1
5	9	24	9	0

In developing the final conversion curve shown in Fig. 7 the information on some twenty oils (Figs. 5 and 6) from various crude sources was used.

The stability ratio is the time required to reach the 2 milligram insoluble per 100 milliliter point at some temperature referred to the corresponding value at 212°F.

In the conversion curve, Fig. 7, the stability ratio is compared with the reciprocal of temperature expressed as degrees Rankin. With this curve it is possible to convert the storage period determined at an elevated temperature to the corresponding storage period at some other temperature.

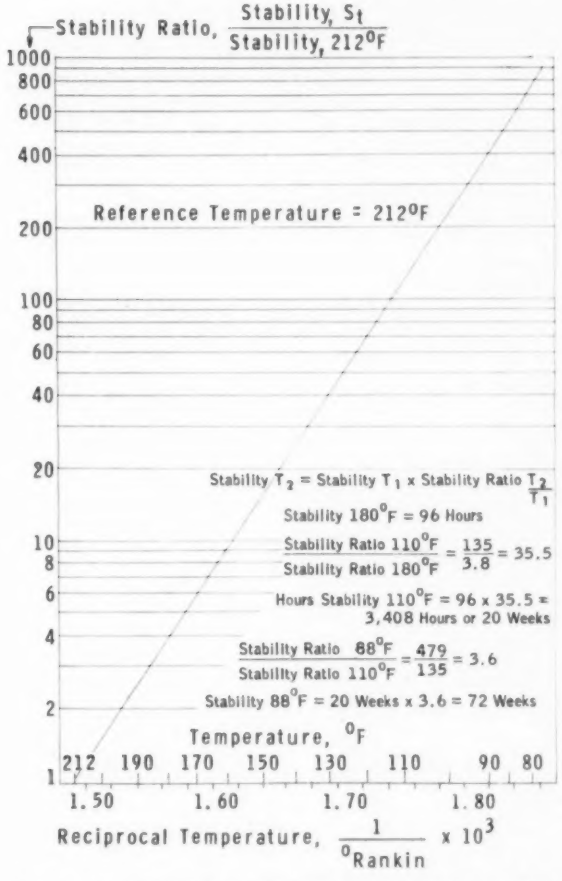

Fig. 7—**STABILITY-TEMPERATURE RELATIONSHIP** for fuel oil used to convert the storage period at one temperature to the equivalent period at another temperature. A sample calculation on this graph shows how to make the conversion.

To illustrate the method used to make this conversion a sample calculation on a fuel oil having 2 milligrams insolubles per 100 milliliters after being stored for 96 hours at 180°F is included in Fig. 7. The stability ratio for 110°F/212°F is 135 ,while that for 180°F/212°F is 3.8. Therefore, the conversion factor for 110°F/180°F is 35.5 and the storage at 110°F is found to be 20 weeks.

Previously, it was stated that the conversion from 110°F to ambient (85°F avg.) had been reported as 4.2. If this factor is recognized, the equivalent storage period at ambient temperature for this oil would be 84 weeks. However, should this temperature be increased 3°F to 88°F the factor would decrease to 3.6 and a storage of 72 weeks for this oil. As a result of recent temperature studies the authors have accepted the 88°F as a more realistic value.

Significance of Results

With the correlation for converting storage times at the elevated temperatures to that of ambient temperature established in the lab, it remained to confirm this data with field test results. Because storage periods of 18 months in the field were impractical and could not be conducted on oils with a range of stabilities, it was decided to con-

duct a series of tests on fuel oils stored in drums where control can be exercised.

To accomplish this testing, the drums were vented in a way similar to that described in a previous article[4] at a temperature of 100°F. Arrangements were made to duplicate breathing by having a temperature cycle, and periodically, the entire drum contents were filtered to determine the insolubles.

From the data obtained on a series of drums it was possible to determine when the 2 milligram point was reached. A laboratory evaluation at an elevated temperature was also completed, and the results compared to the 100°F storage value. The results are recorded in Table 3, and are in good agreement.

The practical significance of the conversion chart to the refiner is probably better emphasized by indicating that a storage of one day at 120°F is equivalent to approximately 1 week at 88°F. As previously indicated it is desirable to have the storage stability of a fuel oil at 88°F equivalent to 18 months.

Because these determinations can be made at elevated temperatures in a matter of hours it is possible for the refiner to control the stability of fuel oils with a calculated risk by utilizing the conversion chart offered here.

Acknowledgement

The authors wish to recognize the assistance received from coworkers J. H. Cromwell, R. M. France, W. J. Lendener, and other members of the staff of the Cities Service Refining Corporation, as well as the Research and Development Company in preparing this material. The authors are also grateful to the Cities Service Research and Development Co. for permission to publish the articles.

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(2) Konrad, W. A., T. S. Tutwiler, N. D. Shipley, "New Fast Method for Distillate Storage Stability," PETROLEUM PROCESSING, Sept. 1956, pp. 145-9.

(3) Rescorla, A. R., J. H. Cromwell, and Daniel Milsom, "Laboratory Evaluation of Fuel Oil Stability," *Analytical Chemistry*, 24 1959-64 (1952).

(4) Smith, H. M., F. G. Schwartz, and C. D. Ward, "Studies on Storage Stability of Diesel Fuels—Results of Storage Time," S.A.E. National Diesel Engine Meeting, November 3, 1953, Chicago, Illinois.

(5) U. S. Bureau of Mines, Petroleum Experiment Station, Bartlesville, Oklahoma. WPRA—Bureau of Mines, Cooperative Distillate Fuel Storage Stability Program, Progress Report No. 3, 1952.

(6) U. S. Bureau of Mines, Petroleum Experiment Station, Bartlesville, Oklahoma. WPRA—Bureau of Mines, Cooperative Distillate Fuel Storage Stability Program, Progress Report No. 6, February, 1955.

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The Authors Sum Up This Section

1—From the data presented in this article it appears that the insolubles greater than the 2 milligram point tend to increase at an accelerated rate.

2—Experimental data on a series of oils over a range of temperatures indicate that the logarithm of storage time to reach the 2 milligram per 100 milliliter point at each temperature plotted against the reciprocal of storage temperature in degrees Rankin gives lines that are practically parallel.

3—By means of the Arrhenius equation a time-temperature relationship was established where time of fuel oil storage at elevated temperatures up to 212°F can be converted to the equivalent time of fuel oil storage at any other temperature.

4—Actual field tests of stability data confirmed the validity of this time-temperature conversion chart for fuel oil stabilities, and the practical application to the refiner was demonstrated.

NEWS in VIEWS

NIGHT GLITTERS around Celanese Corp.'s new polyolefin resin plant now going on stream near Houston

Your Guide to . . . Petroleum Processing Departments

Keep Your Data File Up-to-Date

"Clip-n-File" Process Data

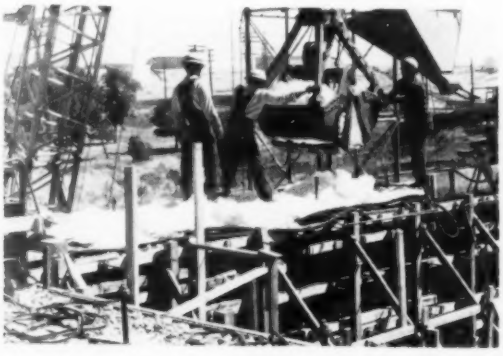
Ammonium Nitrate

The latest process information and flow diagram of Girdler Corp.'s technique. **p. 109**

"Clip-n-File" Engineering Data

Glossary of Plastics—M-Z

Second part of a helpful listing which may dispel some of the confusion in your mind as to what the trade-named plastic materials really are. **p. 129**



Cool Foundation for a Hot Coker

Using ice during construction made concrete stronger and reduced chances of cracking during setting. Plant Practices this month also includes tips on installing a steam regulator, better method for joining electric cable, and other ideas. **p. 113**

It Was Strictly Psychological

The Bull Pen boys this month faced a problem of a rash of equipment breakage that was piling up the downtime for a fare-thee-well. Then the Old Man remembered a stunt he'd used out in Arabia on a construction job, and it worked. **p. 117**

A Perfect 88

. . . and we don't mean a piano. Since New Words began as a regular department almost four years ago, you've added 88 new words to your vocabulary. For the latest definitions for your files, those on acetic acid and ethyl chloride, see . . . **p. 119**

How Chemicals Are Made

Today's methods of manufacture of chemicals and chemical products for today's engineers. Bring yourself up to date with R. Norris Shreve's new 2nd edition of his popular and widely-used "The Chemical Process Industries." Book Reviews. **p. 123**

Oil from Tar Sands

A new system and process for the recovery of oil from such materials, subject of a recent patent issued to Esso Research and Engineering Co., is reviewed in this month's Patents, plus your regular detailed listing of new patents. **p. 137**

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With 10 years on corrosive waste gases this Crane Valve is still maintenance-free

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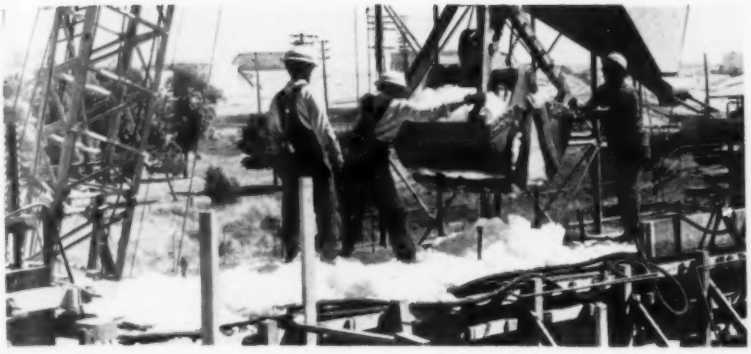


A Cool Foundation For a Hot Coker

HANDLING artificial snow (crushed ice) in a refinery is not as odd as seems. By doing this during construction of its large fluid coker at the Avon, Calif., refinery, Tidewater Oil Co. got a stronger concrete foundation and reduced the chance of creating cracks while the concrete set.

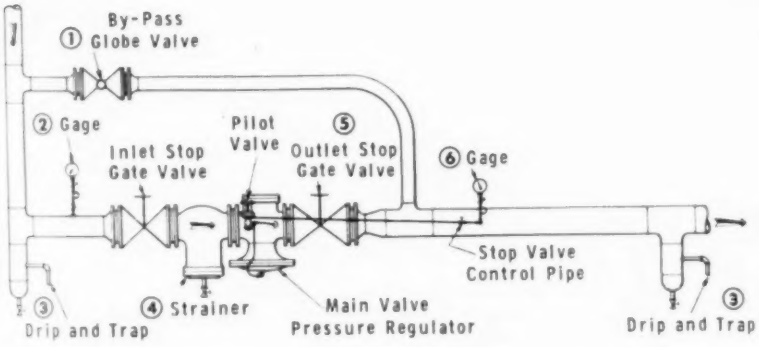
The first step in building the foundation for the 42,000 b/d fluid coker was erection of the wooden forms. Large size aggregate was then put into the dry forms. Included in the forms at this time were pipes through which special grout was to be pumped later.

For about 24 hours before placing the grout, the forms were cooled with crushed ice, shown being placed on top of the forms in the picture, left.

The grout, a special mixture of Type II cement and fine sand, was mixed with ice water and pumped through the pipes into the forms. As the pour proceeded, the pipes were gradually pulled out of the forms. Ice was kept on top of the forms during this time and until the pour was completed.

The main purpose of the ice was to ensure that the concrete cured below 60°F; this reduced the chance of cracks developing during curing. Because considerable heat is created by the curing of concrete, the use of ice on forms prevented shrinkage and assured higher strength.

After the forms were stripped from the concrete, the foundation was painted with a curing compound that helped reflect the heat of the California sun during the final curing.



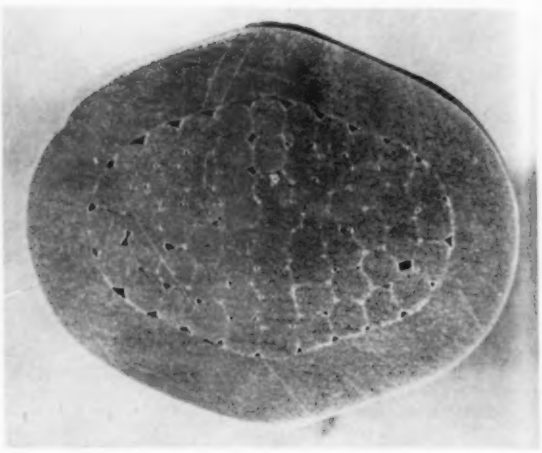
Tips on Installing a Steam Pressure Regulator Station

HERE'S a check list developed by an engineering company for steam regulating installations. Designed to prevent omission of required accessories, this list can be used to ensure safe operation and easy maintenance.

The accessories that should be considered in any regulating station for steam pressure are:

1. **By-pass valve**—the most obvious and least likely to be omitted. But without a by-pass a failure of the regulator will shut down the entire system.
2. **Gage for incoming steam**—permits determining whether operating trouble is in the valve or piping. Quickly tells what pressure loss through the piping is.
3. **Drip and trap**—prevents waterhammer. A dirt leg below the trap takeoff prevents dirt plugging the trap and also acts as a small surge tank.
4. **Strainer**—prevents foreign matter from obstructing closing of the regulator. If mounted next to the regulator, as shown, it can be isolated for cleaning and disassembly while steam is fed through the by-pass.
5. **Stop valves**—on outlet side and control pipe. Without these valves the regulator cannot be isolated for repair, even if the steam is diverted through the by-pass valve.
6. **Gage in control pipe**—indicates what pressure is affecting the pilot and, therefore, what pressure is actually on the downstream side of the regulator. Mounting a pressure gage at same distant point or on the delivery pipe itself will not tell what pressure is controlling the regulator.
7. **Proper maintenance.** Operate the by-pass and shut-off valves frequently to make sure they will not be "frozen" when needed in an emergency. Clean out the strainer frequently.

(Turn page for two more ideas)



Join Cable by Squeezing, Not Soldering

POWER for a 20,000 cfm catalyst blower at Sinclair Refining Co.'s Marcus Hook, Pa., refinery is critical. Operated by a 2000 hp motor, the blower provides air for circulating and regenerating the cracking catalyst. Electric power is supplied through a 3/0 aluminum compact-sector cable.

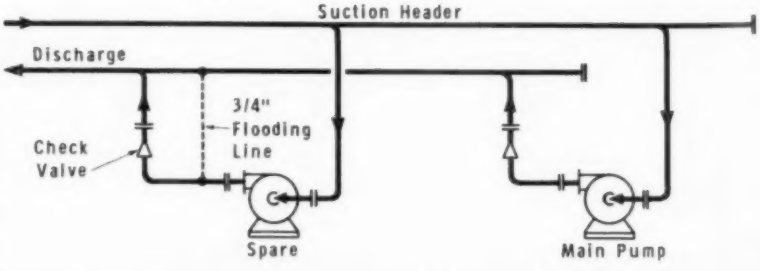
Knowing that to splice this power cable was important, Sinclair decided to use compression sleeves rather than soldered joints, and to use aluminum instead of copper sleeves. The reasons for this were: a safe installation without heat or flame, simpler installation procedures, and a more reliable connection.

Copper connectors would have caused two difficulties. The aluminum would have been eaten away by galvanic action in the copper sleeve in the presence of any moisture; and the difference in expansion between the two metals would have meant a loose joint. Because aluminum expands and contracts 38% more than copper, a copper sleeve compressed over aluminum cables would have meant tight compression in cold weather and looseness in warm weather. The use of the same aluminum metal for sleeves means constant compression and, resultingly, good electrical contact.

In making the splice special measures must be taken to ensure a good electrical contact. Because a film of aluminum oxide forms on exposed aluminum, it is necessary to remove it before final compression of the joining sleeve connectors. Coating the end of the cables with oxide inhibitor compound or zinc chromate paste, and rubbing the oxide film off with fine emery cloth or a wire brush, is recommended. Petroleum jelly or a light machine grease may also be used to seal the freshly cleaned aluminum against the air until the connectors are compressed.

Using the hydraulic compression unit shown above (a 40-ton splicing head with dies), it's possible to compress the cable strands and connector until they are almost one solid unit. Any oxide film left on the strands is rubbed off during the compression by the tremendous pressure. The cross-section view at the right shows extreme compression.

Sinclair found that by using this method of splicing it was possible to work safely in the underground manholes where the cable was installed, without fear of explosion from a soldering flame. The hydraulic compression tool is light and portable and can be used easily in confined spaces.



How to Prevent Vapor Lock

VAPOR locking of spare centrifugal pumps is always a possibility when a main pump fails. The reduced pressure on the suction header will drop the net positive suction head (NPSH) so that the spares will not pick up suction when put onstream.

L. H. Furen, operator in the cracking coils department of Humble Oil and Refining Co.'s Baytown refinery, suggested a simple and convenient hook-up that assures proper operation of a spare pump when the main pump fails. (see drawing above.)

A short run of ¾-in. pipe connects the discharge header and the spare pump to provide positive flooding of the pump casing at all times. The small ¾-in. line at Humble's installation connects into the discharge line of the spare pump, upstream of the check valve, as shown. This provides low-cost insurance against pump failure because of vapor lock.

Strictly Psychological

"We were building a refinery in the middle of the desert . . . "

WE'D JUST got word that a crawler crane had turned over in the north tank farm and the Old Man was fit to be tied. We were hotfooting it out there to see what had happened and what could be done.

"Who's on that crane?" the Old Man asked.

"Sammy, I guess."

"Mighta known it!" the Old Man growled. "That guy is a foul ball if I ever saw one!"

The Old Man was partly right. Anyway you looked at it, Sammy could get in more trouble with a crane than anybody else in the plant. I preferred to think of Sammy as being downright unlucky though, because it wasn't always his fault. If hens were laying dollar bills, Sammy would be working in the ice house that day—that was how Sammy's luck ran.

Anyway, we got there and were relieved to see that Sammy wasn't hurt. But that machine was a sorry looking mess. It was laying on its side with both tracks in the air and the boom draped across a firewall like a string of spaghetti. Sammy was poking at the underside of the machine waiting for men and equipment to come and repair the damage.

"Alright, Sammy, watcha gonna do now?" The Old Man was trying to take care of his blood pressure.

"Well," said Sammy, "I reckon I'll clean the tracks and grease 'er. I'll never have a better chance."

At that point, the Old Man reminded me of a mercury thermometer. The red started creeping up over his shirt collar and kept climbing. His blood pressure was soaring.

He didn't say a word to Sammy or me, but he jumped in his car and headed back for the plant. I didn't want to ride with him in this mood, but it was too hot to walk, so I tagged along.

Back in the Bull Pen, the Old Man let go. "I'm damned if we're not gonna have to get spares for all our equipment around here. I never saw so much foolish wreckage in all my life!" He was right this time—we'd had a rash of equipment breakage for about a month and it was all the shops could do to keep everything rolling.

"Solly, tell 'em how I stopped all that boom breaking we had over in Arabia." The way the Old Man had started, I could tell that Solly didn't have the slightest chance of telling any kind of a story—this was going to be the Old Man's show. I settled back to listen to his yarn.

"It was back in 1938," he continued. "We were building a refinery in the middle of the desert—hotter'n the hinges of hell. All the crane operators were Arabs." He pronounced it Ay-rabs.

"I always figured these Arabs were lazy, but I later decided that they were just smarter than we were. What with the temperature running 140° in the shade, these guys would rest every chance they got. If they didn't have an opportunity, they made one.

"One of the schemes these Arabs had was to foul up the crane booms as fast as we could fix 'em. They'd pick out a bare spot somewhere and drop the booms. They always managed to damage the booms just bad enough so that the riggers would have to make a new boom or a new section for replacement.

"To make a new boom, or repair one, usually took about two days. All this time the operators would be lying out in the shade of the machine taking life easy. Not only that, but the whole job would be slowed up and half the other workers would be sitting around in the shade, too. You can't work a construction job without cranes.

"These Arabs were driving me nuts. We had three 70-ton cranes on the job and at least one of them was down all the time. There was usually one boom just repaired, one broken, and one about to break.

"Well, as I said, this was enough to drive a man out of his mind. But I got to thinking—it only took about an hour to change a boom after the new one was fabricated. I figured that if we could get ahead on booms and have a spare on hand all the time, we'd stop a lot of this downtime.

"So, we worked an extra gang on making up two spare booms. When we got 'em finished, we hauled 'em out to the edge of the site where those crane operators could see 'em every time they swung around.

"Now tell 'em what happened, Solly."

"Well . . . ," Solly started. That was as far as he got.

"That's right," the Old Man took up where he had left off. "We never had to use those booms. These Arabs could see that the most rest they could get out of a busted boom was about an hour—the truth of the matter was that our boys had had so much practice, they could change a boom out in thirty minutes. So these operators had to think of something else that wasn't so easy. But it sure stopped crane downtime for the rest of that job."

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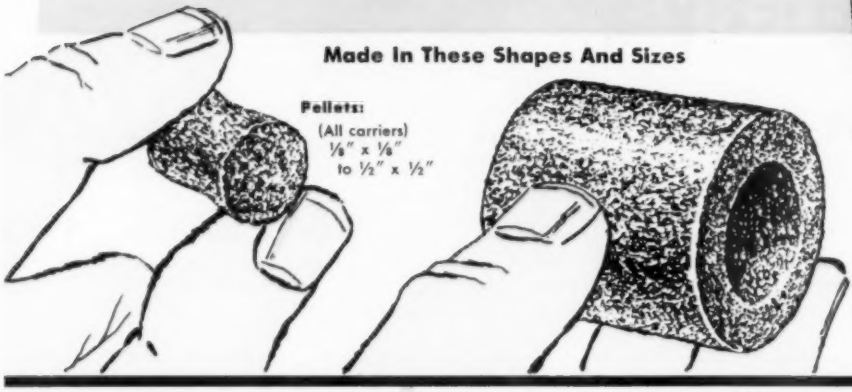

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Intermediate Surface Area Type A	45-50%	28-30%	1.65-1.70 gr/cc	58 lbs/ft³ (Approx.)	Quartz, Alpha, Gamma Alumina — chiefly Gamma Alumina	60-70m²/gm
Type B	45-50%	28-30%	1.65-1.70 gr/cc	60 lbs/ft³ (Approx.)	Quartz, Alpha, Kappa, Delta Alumina	20-30m²/gm
Type C	45-50%	28-30%	1.65-1.70 gr/cc	62 lbs/ft³ (Approx.)	Alpha Alumina and Mullite	5-10m²/gm
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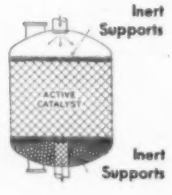

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(To obtain more data on advertised products see page 154)

Do You Know These Words?

A regular department intended to help administrators and operating men keep abreast of technical names and process in the petrochemical field.

By B. H. WEIL

Manager, Information Services
Ethyl Corp. Res. & Engrg. Dept.
Detroit, Mich.

Acetic Acid

Acetic acid, pronounced "ah-see-tihk ass-id," is a petrochemical that in dilute form is known to every housewife as vinegar. Previously from nonpetroleum sources, it has the formula CH_3COOH and is a clear, colorless liquid with a very pungent odor. Its freezing and boiling points are somewhat higher and its weight somewhat heavier than that of water.

Acetic acid has many important uses. It is employed extensively in the manufacture of acetic anhydride and hence in the manufacture of the acetate plastics and fibers (rayon, etc.). As a solvent and reagent, it is used in the rubber, dye, pharmaceutical, insecticide, and photographic-chemical industries. The acetate esters produced from it are themselves important chemicals.

Acetic acid used to be produced almost exclusively by the bacterial oxidation of ethyl alcohol (now a petrochemical as well as a fermentation product). Other commercial methods of synthesis now in extensive use are the air oxidation of acetaldehyde and the reaction of methanol and carbon monoxide. As described in previous items in this series, all of these intermediates are largely produced from petroleum and natural gas, via such intermediates as ethylene, acetylene, and methane-derived water gas.

Some production continues to come from the destructive distillation of wood, although this has long since ceased to be an important source. Its uses are expected to increase steadily.

Ethyl Chloride

Ethyl chloride, pronounced **"eth-**ihl **klaw-**ride," is a petrochemical of long standing that continues to find increasing use. It has the formula CH_3CH_2Cl (ethane in which one hydrogen atom has been replaced with an atom of chlorine), and is a gas at room temperature, slightly lighter than air.

Chief among the uses of ethyl chloride are the manufacture of tetraethyl lead and ethyl cellulose plastics. In addition, this chemical finds use in medicine and dentistry, in refrigeration, in insecticides, in organic synthesis and as a solvent for such substances as sulfur, phosphorus, fats and oils, and various resins and waxes.

While some ethyl chloride is a byproduct of the synthesis of chloral, most of it is obtained commercially by the reaction of ethylene and hydrogen chloride, or the reaction of ethyl alcohol and hydrogen chloride. All of these intermediates are themselves petrochemicals, ethylene being obtained as a byproduct from cracking operations or by the deliberate cracking of petroleum fractions ranging all the way from residuals to ethane, and hydrogen chloride being produced from byproduct hydrogen from catalytic reforming of naphthas. Ethyl alcohol is synthesized from ethylene. It is true, of course, that these intermediates are also produced commercially from nonpetroleum sources, but petrochemical synthesis dominates.

Because of its high-volume uses, ethyl chloride is one of the major petrochemicals. Output is well over 300,000 t/yr. Because demand for its derivatives is expected to continue to grow, its output should also increase.

NEWS in VIEWS

BUILT-IN BRAIN is a first. Fischer & Porter's computer is being readied for installation as an integral part of the processing set-up at the Belot refinery of Esso Standard, S.A., near Havana, Cuba.

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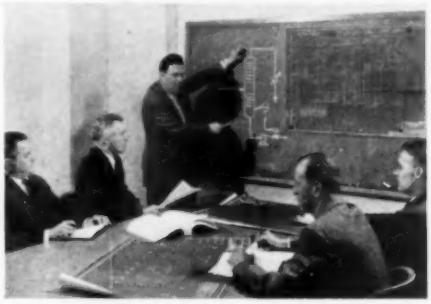

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Process Industry Data Updated

The Chemical Process Industries, 2nd ed., R. Norris Shreve, 1956, 6¼ x 9½ in., 1004 pages, indexed, illustrated, hard cloth cover, $11.50, McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y.

THE SECOND edition of Mr. Shreve's popular book on the process industries has been expanded to include new illustrations and up-to-date information. It continues to be a convenient reference to methods used in the manufacture of chemicals and chemical products—broken down into units processes and operations by convenient flow sheets.

Each of the chemical process industries is analyzed and described by flow sheets that show the interrelationship of the basic unit processes and unit operations. Items covered include data on chemical and physical changes and reactions, economics statistics and costs, energy and power needed, etc. Where figures are available, quantities of materials needed to produce the finished product are given.

Some of the process fields covered in *The Chemical Process Industries* include the petroleum industry, petrochemicals, plastics, synthetic fibers, ceramics, paints, explosives, and pesticides. There is ample use of tables and flow sheets, together with typical problems, to give a clear picture of each process and the whole chemical process industry.

Book Briefs

Commercial Waxes, H. Bennett, Editor, 698 pages, 5½x8½ in., 1956, $15.00, Chemical Publishing Co., 212 Fifth Ave., New York 10, N.Y.

. . . an enlarged and up-dated edition with additional information on natural and synthetic waxes, wax blends and wax-resin compositions. Book covers mineral, vegetable, animal, synthetic and compounded waxes in detail. Numerical data on physical and chemical properties, solubilities, and uses are listed for all waxes. Includes a symposium with contributions from experts and leading manufacturers; a formulary from every important branch of the chemical industries using waxes as raw materials or modifying agents.

Vapor-Liquid Equilibrium Data, by Ju Chin Chu and associates, 760 pp, 5½ x 8½ in., Tuscan binding, $9.00, J. W. Edwards, Inc., Ann Arbor, Mich.

. . . sequel to "Distillation Equilibrium Data" (1950), adds data developed from that time to June, 1954. Index refers to data systems listed in earlier volume as well as those in present work. Book includes 466 systems from 274 references. Data, expressed in mole-%, are tabulated together with temperature (°C) and pressure (mm Hg) in alphabetical order by common name of the component that is more volatile than the others in the pure state.

A Manual of Processes for the Cold Bending of Metals and Abrasive Cut-Machining of Metals, 1956, totals 170 pp, notebook form, $2.50, published by Wallace Supplies Manufacturing Co., 1304 Diversey Parkway, Chicago 14, Ill.

. . . two sections on bending, two on cutting, the former available separately at $2, the latter at $1. Bending chapters describe types of machines and tools used for bending, designing for bending, theory of cold bending, and other topics. The second section was written by E. D. De Witt and F. D. Alexander and is a reprint of a work originally published by the American Society of Mechanical Engineers.

ASTM Standards on Electric Insulating Materials (D-9), 656 pp, 6 x 9 in., heavy paper cover, $6.00 ($4.50 to members), American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

. . . includes 12 revisions and two new items (silicone insulating varnishes and a recommended practice for cleaning plastic specimens for insulation resistance testing) since last year's edition. Altogether there are 83 methods of test and specifications.

ASTM Specifications for Steel Piping Materials, prepared by ASTM Committee A-1 on Steel, 1955, 6 x 9 in., 432 pp., illustrated, table of contents, paper cover, $4.00, American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

. . . contains latest approved form of 58 ASTM specifications for ferrous pipe, tubes, casting, fittings and bolting materials.

Symposium on Atmospheric Corrosion of Non-Ferrous Metals (ASTM Special Technical Publication No. 175), 164 pp, 6 x 9 in., heavy paper cover, $2.75, American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

. . . lists all data gleaned from specimens exposed to atmospheric corrosion for 27 years. Also includes nine papers that discuss results of the test (one of the most comprehensive ever attempted) in each metals field—zinc, nickel, copper, lead, tin, and aluminum.

ASTM Standards on Copper and Copper Alloys, Dec., 1955, 654 pp, 6 x 9, heavy paper cover, $5.75, American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

. . . includes the latest form of 127 standards—110 specifications, 12 test methods, two recommended practices, two classifications, and one definition of terms. Fifty of the specs have been revised and a new one for threadless copper pipe has been added since the previous edition.

ASTM Standards of Metallic Electrical Conductors, by Committee B-1 on Wires for Electrical Conductors, Dec., 1955, 300 pp, 6 x 9, on heavy paper, $3.50, but $2.65 to members, published by American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

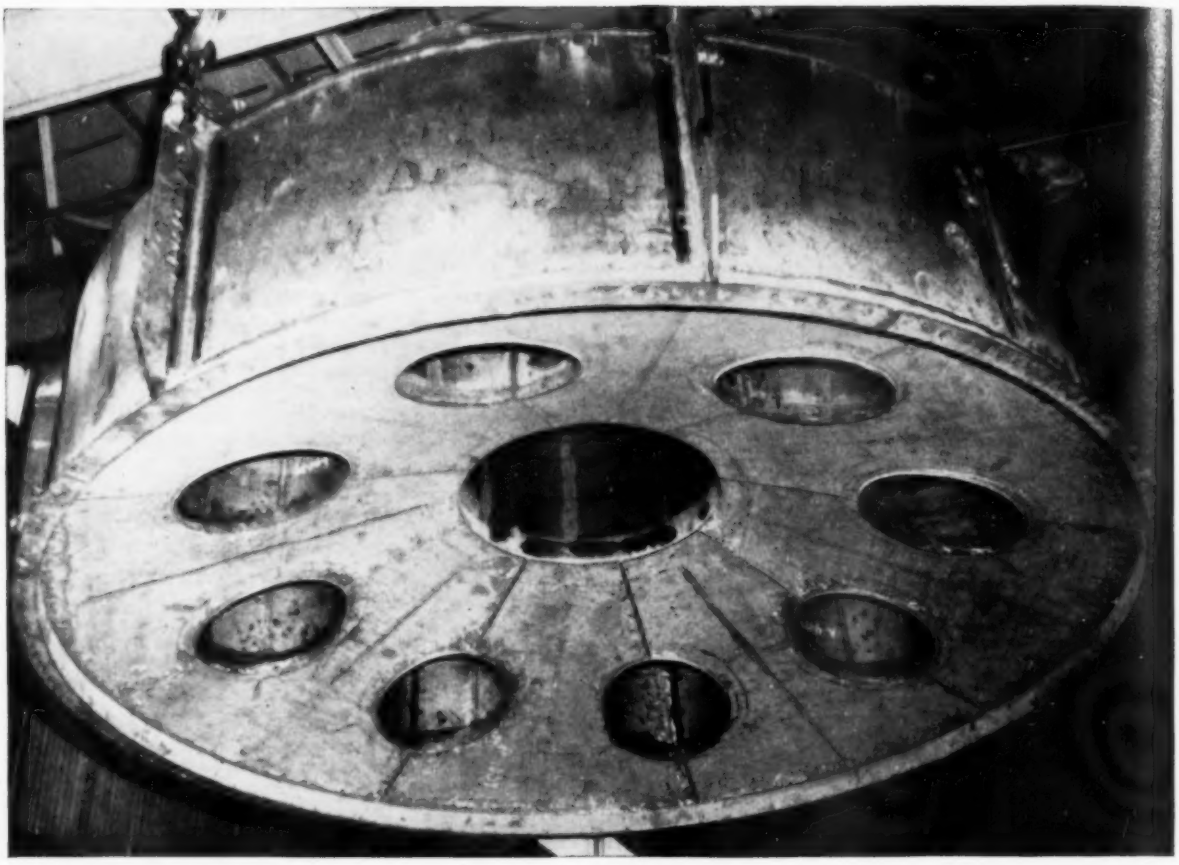
. . . includes 52 standards—43 specifications, seven test methods, one recommended practice and one classification of coppers. The standards cover copper, aluminum, and galvanized metals in various combinations.

Minerals Yearbook—Fuels, Vol. 2, 1953, by the U. S. Bureau of Mines, 478 pp, cloth bound, 6 x 9 in., $2.25, published by U. S. Printing Office.

. . . includes chapters on each mineral-fuel commodity, as well as some on the industry as a whole, a statistical summary, and an employment and injury analysis.

Speak to the Earth, by Max Miller, 1955, 6 x 8½ in., 310 pp., illustrated, stiff cloth cover, $3.75, Appleton-Century-Crofts, Inc., 35 W. 32nd St., New York 1, N.Y.

. . . tells story of America's oil industry pioneers in narrative form starting with early Indian worship of the black stuff from the earth, and looking ahead to petroleum's effect on the future.



Hat size 240

Talk about ten gallon hats, here's a lid for a vaporizer that measures twenty feet in diameter. There were special problems of tailoring. There had to be stainless steel where the vapors flow to resist corrosion, and a carbon jacket to contain steam for heating.

The dome on top of this vaporizer acts as an inverted funnel. The holes you see in the dome are the outlets for the corrosive vapors. With an injection of steam, in the jacketed area of the dome, these vapors are re-heated to keep them in a gaseous state 'til they reach the next step in process.

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(To obtain more data on advertised products see page 154)

PERSONALS

A. S. Gilliam has been made plant manager of Great Northern Oil Co.'s Pine Bend refinery, at Pine Bend, Minn. He was formerly with Olin-Mathieson Chemical Corp. as project manager and assistant plant manager.

Before that Gilliam worked with Shell Oil Co. at Houston and Wood River, Ill.

Warren A. Beman has been appointed head of the marketing division of the recently formed petroleum chemicals department at Socony Mobil Oil Co. **Frederick P. Richter** has become head of the technical division in the department.

Beman was head of the process products group, industrial division, of Socony's lubricating department. He is a chemical engineering graduate of Purdue.

Richter's last Socony assignment was as supervisor of the chemical section in the research and development lab at Paulsboro. Since then he has worked in the technical staff of General Petroleum Corp.'s manufacturing department. He holds A.B. and M.A. degrees in chemistry from Temple University and a Ph.D. in chemistry from the University of Illinois.

Everett M. Barber, The Texas Co., has received the Richards Memorial Award for achievement in mechanical engineering. Presentation was made at the recent annual meeting of the American Society of Mechanical Engineers.

Mr. Barber

Barber is supervisor of special engine research at the Texaco research center in Beacon, N. Y. He is the inventor of the Texaco Combustion Process. He received a B.S. in mechanical engineering from Pennsylvania State University in 1931, and his M.S. in 1933. He has been with Texaco since then, except for one year when he held an engineering fellowship at Harvard University.

Dr. **Tracy M. Patrick, Jr.,** has been made an assistant director of research at Monsanto Chemical Co. He was a group leader in the Organic Chemicals Division's research department. He holds a doctorate in organic chemistry from Purdue University, class of 1942.

Reader G. Anderson has taken over the post of assistant general superintendent of operations and utilities at the Texas City refinery of American Oil Co. He succeeds **William A. Sullender,** who has been transferred to New York as assistant to the manager of operations in the marketing department.

Anderson has been on a temporary assignment in New York as assistant to the general manager of manufacturing.

John Cogan has become head of the technical department at the Bayway refinery of Esso Standard Oil Co. He has been replaced as head of the technical department at Esso's Bayonne refinery by **Russell Ernest,** formerly assistant manager of Esso's east coast technical service division.

Cogan is a graduate of M.I.T. and Colorado College and began with Esso in 1936. Ernest was graduated from Bucknell University in 1942 and joined the Bayway refinery.

I. W. Scroggin has been appointed assistant plant manager in charge of technical services for the East Chicago, Ind., refinery of Cities Service Oil Co. He was formerly a staff engineer in the manufacturing department of Cities Service Petroleum, Inc., in New York City.

Fred H. Ramseur, Jr., has joined the New York headquarters as coordinator of light ends and natural gasoline plants. For several years he has been manager of the natural gasoline division of Arkansas Fuel Oil Corp.

H. E. Hughes, superintendent of Shell Chemical Co.'s Houston plant, has become the new manager of the Denver plant, succeeding the late **J. G. Bejarano.** The superintendent's post at Houston has been assumed by **J. W. Hyde,** who was assistant superintendent of operation.

F. G. Watson, assistant to the manufacturing vice-president, has been made assistant manager of manufacturing development. His post has been taken by **C. H. Plomteaux,** formerly assistant superintendent at the company's Norco plant.

Carl W. Peters has become technical director of Pan-Am Southern Corp.'s Destrehan, La., refinery. He replaced **H. A. Parker,** who has been transferred to New York as assistant manager of operations in the manufacturing department of American Oil Co., an affiliated company. Peters was formerly chief process engineer.

John H. Bryant has been named group leader in charge of coordination and economics at Destrehan, and **William E. McWhirter** has been appointed group leader of technical service and process engineering. Both were process engineers.

Mr. Kirkbride

Mr. Kennedy

Chalmer G. Kirkbride has joined Sun Oil Co. as executive director of the research, patent and engineering departments. He has resigned as president and chairman of the board of Houdry Process Corp.

In another executive change at the company **Dr. J. Bennett Hill** has retired as director of the research and development department. He helped manage Sun's research program for the past 22 years.

Dr. Hill's successor is **Dr. Charles L. Thomas,** who was associate director of research and development. **Robert M. Kennedy** has filled this post, and his former job, manager of the basic research division, has been assumed by **Abraham Schneider.**

Dr. Sherman S. Shaffer has been elected chairman of the American Chemical Society's Division of Petroleum Chemistry for 1957. He is staff associate in the technical and research divisions of Humble Oil and Refining Co., Baytown. Shaffer succeeds Dr. Alex G. Oblad, manager of research and development of Houdry Process Corp.

H. B. Coons has been appointed plant superintendent of Carbide and Carbon Chemicals Co.'s Niagara Falls plant. He succeeds **W. C. Heidenreich,** who has been made associate

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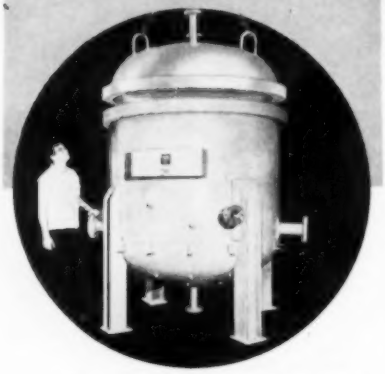

You get low-cost clarification of gasolines, fuel oils, petro-chemicals — practically all liquid petroleum products — with Fulflo Filters. There's a Fulflo Filter for almost any operation — refining, processing, bulk filtration, dispensing.

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Plants in Melrose, Massachusetts and Lebanon, Indiana

director of the general industrial relations department and will deal with technical recruiting.

Coons moves to Niagara Falls from the South Charleston plant.

Mr. Wilson

Mr. Miller

L. T. Wilson manager of the Montreal East refinery of Shell Oil Co. of Canada, has been appointed director of refining and supplies of Compania "Shell" de Venezuela. He has been succeeded in Montreal by **J. L. Miller,** superintendent-operations of Shell Oil Co.'s Houston refinery.

The post at Houston has been taken over by **A. J. Wood,** who was chief technologist at the Wood River, Ill., refinery.

Two promotions have been announced at Humble Oil & Refining Co.'s Baytown, Texas, refinery, technical and research divisions:

T. M. Newsom has been promoted to senior chemical engineer. He holds a B.S. degree in chemical engineering from the University of Texas.

C. L. Thorpe has been made senior research chemist. He received a B.A. degree in chemistry from Cornell College (Iowa).

Dr. Ellis K. Fields has been appointed a group leader in the research department of Standard Oil Co. (Ind.), Whiting. He will do exploratory research with high-octane hydrocarbons and petrochemicals.

D. M. Cox has been appointed assistant general manager of the Esso Standard Oil Co. supply department, a new post in the New York headquarters. Cox has been manager of the petroleum products division at the Baton Rouge refinery. He is a chemical engineering graduate of Virginia Polytechnic Institute.

R. Wolcott Hooker, senior vice-president of Hooker Electrochemical Co., has been reelected president of the Synthetic Organic Chemical Manufacturers Association.

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MOBILE, Ala., Shook & Fletcher
NASHVILLE, Southern States Iron Roofing Co.
NEWARK, N. J., Eastern Steam Specialty Co.
NEW HAVEN, Conn., Insulation Supply Co.
NEW ORLEANS, Eagle Asbestos & Packing
NEW YORK, Eastern Steam Specialty Co.
OKLAHOMA CITY, Ball Distributing & Engineering Co.
OMAHA, Cardinal Supply & Mfg. Co.
PHILADELPHIA, John F. Scanlan, Inc.
PITTSBURGH, Dravo Corp.
PHOENIX, Ariz., Kircher Asbestos & Rubber Co.
RALEIGH, N. C., Southern States Iron Roofing Co.
RICHMOND, Va., Southern States Iron Roofing Co.
ROCKFORD, Ill., Mott Brothers Co.
SALT LAKE CITY, Bullough Asbestos Supply Co.
SAN ANTONIO, The Bracken Co.
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SAVANNAH, Ga., Southern States Iron Roofing Co.
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SYRACUSE, N. Y., Industrial Supply Co.
TAMPA, Fla., Eagle Roofing & Art Metal Works, Inc.
TALLAHASSEE, Fla., Capital Refrigeration & Supply
TULSA, Okla., Ball Distributing & Engr. Co.
TUPELO, Miss., Paine Supply Co.
WASHINGTON, Walter E. Campbell Co., Inc.
WICHITA, Jamar-Olmen Construction Co.
VANCOUVER, B. C., Fleck Brothers Limited

Glossary of Plastics

Plastics are substances of high molecular weight. In the finished state they are solid, but somewhere in manufacture they are soft enough to be shaped by heat and/or pressure.

Two major types of plastics are made: **thermosets** which harden into a permanent shape that cannot be changed, and **thermoplasts** that soften when heat is applied and harden again when cooled.

The following list of plastics (plus those in EDS No. 13) include both general types and *trade names*, and are apt to be used in refineries, natural gasoline and petrochemical plants.

This Plastic . . . (Trade name)	(Chemical name)	Made by . . .	Is used for . . .	For these properties
Maranyl	nylon compounds	Imperial Chemicals Ind.	gears, containers	abrasion, chemical resistant
Marblette	phenolics, epoxies	Marblette Corp.	adhesives, coatings	inertness, water resistance
Marco	polyester resins	Celanese Corp.	electrical embedment glazing, glass mats	flame, corrosion resistance
Marlex	polyethylene	Phillips Chemical Co.	pipe, bottles, film	toughness, chemical resistance
Marvinol	polyvinyl chloride	Naugatuck Chemical Div.	wire covers, hose, pipe	chemical resistance
melamine resins	melamine-formaldehyde compounds	———	adhesives, finishes, electrical parts	boilproof, durability arc resistance
Melantine	melamine resin	Ciba Co., Inc.	dinnerware, handles	impact strength
Melmac	melamine resins	American Cyanamid	dinnerware	(now a quality rating—see Cymel)
Micabond	mica with binder	Continental-Diamond Fibre	tape, tubing	insulation against heat
Micarta	laminated plastics	Westinghouse Electric	tanks, valve bodies	chemical resistance
Mylar	polyethylene terephthalate film	Du Pont	insulating tape, recording tape	high strength, chemical resistance
Mycalex	glass-bonded mica	Mycalex Corp.	electrical parts	electrical insulation
Nebony	petroleum resin	Neville Chemical Co.	floor tiles, adhesives	resistance to moisture
Neillite	phenolic resins	Watertown Mfg. Co.	electrical parts	corrosion resistance
neoprene	polymer of 2-choro-butadiene-1,3	Du Pont	gaskets, hoses, linings	resistance to oil, ozone
Nitron	cellulose nitrate	Monsanto Chemical	optical frames	resilience
non-rigid plastics				moduls of elasticity less than 50,000 psi at 25°C (ASTM D747-43T)
novolaks	phenol-formaldehyde resins	———	varnishes	(can become thermosetting by curing)
nylon	polyamides	———	bearings, gears, bristles	abrasion, chemical resistance
Opalon	vinyl chloride	Monsanto Chemical	handles, electrical parts	resists abrasion, chemicals
Orizon	polyethylene	Monsanto Chemical	containers, film	chemical resistance, toughness
Orlon	acrylonitrile polymer	Du Pont	filters, clothing	resistance to acids
Paracril	Buna-N, nitrile synthetic rubber	Naugatuck Chemical	hose, gaskets	resistance to oil and gasoline
Paradene	coumarone-indene	Neville Chemical Co.	coatings, asphalt tile	water resistance
Paraplex	polyester resins	Rohm & Haas	glass fiber laminates	resistance to weathering
Parapol	styrene-isobutylene copolymer	Enjay Co.	film, coating	
Parlon	chlorinated rubber	Hercules Powder Co.	paints	corrosion resistant film
Penton	chlorine polyether	Hercules Powder Co.	valves, gears, rope	chemical, abrasion resistance
Perlon	isocyanate	Farbenfabriken Bayer	bristles	abrasion, chemical resistance
Perspex	methyl methacrylate	Canadian Industries Ltd.	glazing, lenses	light transmission, weathering
Petrothene	polyethylene	U. S. Industrial Chemicals	wire covering	electrical insulation
phenolics	resins of phenol-aldehyde condensation	———	adhesives, electrical parts	corrosion resistance, dielectric strength
Plaskon	(many plastics)	Barrett Div.		
plastisols	mixtures of resins and plasticizers	———	molding, casting	
Plastacele	cellulose acetate	Du Pont	face shields, covers	resistant to hydrocarbons
plasticizer	high boiling solvent	———	flexibility, softness	to modify plastic resins
Plexiglas	methyl methacrylate	Rohm & Haas	goggles, glazing	transparency, shatterproof
Plio-Tuf	styrene copolymer	Goodyear Tire & Rubber	hoods, tote boxes	toughness, resistant to heat
Pliovic	vinyl chloride polymers	Goodyear Tire & Rubber	hose, gaskets, tubing	chemical resistance
polyamides	polymers with amide linkages (nylons)	———	valve seats, gears, bristles, bearings	strength, abrasion resistance, low coefficient of friction
polyesters	resins from polyhydric alcohols and polybasic acids	———	casting, reinforcing	heat resistance, weathering, corrosion resistance
polyethylene	polymerized ethylene	———	containers, pipe, coatings, packaging, film	resistance to solvents, chemicals, water; flexible
Poly-Eth	polyethylene	Spencer Chemical Co.	containers, pipe, film	(see above)
Polylite	polyester resins	Reichold Chemicals	housings, laminations	weathering, corrosion resistance

Note: Names of plastics in italics are *trade names*.

This Plastic . . . (Trade name)	(Chemical name)	Made by . . .	For these properties	Is Used for . . .
reinforced plastics	plastics reinforced with fibers (glass)	———	tanks, ducts, hulls	corrosion resistance, high strength, easily formed
Resimene	melamine resins	Monsanto Chemical Co.	housings, adhesives	boilproof, corrosion resistance
Resinox	phenolic resins	Monsanto Chemical Co.	grinding wheels, linings	corrosion resistance, binding
resins	solid or semi-solid organic products	———	plastics, adhesives	water insoluble, no definite melting point
Riji-Tuf	styrene compound	American Hard Rubber	housings, cases	impact strength
Resistoflex	vinyl alcohol compound	Resistoflex Corp.	tubing, gaskets	resistant to hydrocarbons
Rulan	polyethylene compound	Du Pont	wire insulation	does not support combustion, high-frequency dielectric strength
Saflex	vinyl butyral	Monsanto Chemical Co.	safety glass interlayer	clarity, weathering
Saran	vinylidene chloride	Dow Chemical	pipe, screens, filters	resist acids and alkalies
Seilon	polyvinyl chloride, or modified styrene	Seiberling Rubber	sheets, plates	corrosion resistant
Silastic	silicone rubber	Dow Corning Corp.	diaphragms, gaskets, greases, gaskets, insulation, water repellants	low temperature flexibility
silicones	silica and methyl chloride product	———		heat stability, resists oxidation
Stokoflex	styrene compound	Stokes Molded Products	cases, pipe fittings	toughness, heat resistance
Stypol	polyester-styrene	H. H. Robertson Co.	electrical equipment	heat resistance, insulation
Styrex	acrylonitrile-styrene	Dow Chemical Co.	pipe, ducts	chemical resistance, hardness
Styrofoam	foamed styrene	Dow Chemical Co.	insulation	chemical resistance
stereospecific plastics	isotactic polymers	Montecatini	fibers, films, rubbers	high strength, heat resistance
Styron	polystyrene	Dow Chemical Co.	electrical parts	dimensional stability
Super Dylan	polyethylene	Koppers Co.	pipe, containers, cases	high strength, resists chemicals
Sylplast	urea resin	Sylvan Plastics	adhesives, housings	water resistance
Synthane	laminated plastics	Synthane Corp.		
Synvar	urea, phenolic resins	Synvar Corp.		
Teflon	polytetrafluorotheylene	Du Pont	diaphragms, gaskets	inertness, heat resistance
Tenite	(several plastics)	Eastman Chemical Prod.	pipe, containers, film	———
Terylene	polyethylene terephthalate	Imperial Chemicals Ind.	filters, clothing	chemical resistance
Textolite	laminated plastics	General Electric Co.	gears, elec. insulation	corrosion resistance
Thiokol	polymers from dichlorodiethyl-formal and an alkali polysulfide	Thiokol Chemical	hose, sealants, gaskets	resists oil, oxygen, solvents
Translux	polyester sheet	American Polyglas Corp.	panels, roofing	light transmission, weathering
Tygofil	cast epoxy	U. S. Stoneware Co.	patching, molding	strength, chemical resistance
Tygon	vinyl chloride	U. S. Stoneware Co.	tubing	inertness, toughness
Tynex	nylon filaments	Du Pont	brushes, sutures	resist solvents, acids, abrasion
Ultramid	polyamide	Badische Anilin & Soda-Fabrik A.G.	gears, pipe, bearings	resists oils, solvents
Ultron	vinyl chloride	Monsanto Chemical Co.	vapor barriers, panels	toughness, inertness
urea resins	urea-formaldehyde	———	adhesives, coatings	resist water, mild acids
Velon	vinyl types	Firestone Plastics	hose, screens, coverings	corrosion resistance
Versamid	polyamide resins	General Mills	adhesives, coatings	binding strength
Vibrin	polyester resins	Naugatuck Chemical Div.	reinforced plastics	strength, chemical resistance
Vicara	corn protein	Virginia-Carolina Chem.	textile fibers	comparable to wool
Vinyfoam	vinyl plastisol	Interchemical Corp.	cushions, insulation	insulation, sound deadening
Vinylite	vinyl plastics	Union Carbide & Carbon	hose, coatings	chemical resistance
vinyls	resins formed by polymerization of chemicals with CH_2=CH—groups	———	coatings, sheets, films	———
Vinyon	vinyl resin	Union Carbide & Carbon	textile fibers	chemical resistance
Vinyon HH	vinyl fiber	American Viscose	filters, work clothing	chemical resistance
Vipla	polyvinyl chloride resin	Montecatini (Chemore Corp.)	pipe, valves, ducts	corrosion resistance
Visqueen	polyethylene film	Visking Corp.	vapor barrier, covers	water impermeability
Viton	vinylidene fluoride, hexafluoropropylene copolymer	Du Pont	gaskets, seals	resists corrosive chemicals, flexible after exposure to air, oils
vulcanized fibre	laminate built up from cotton cellulose paper	———	gears, washers, valves	high strength, elec. insulation
Vygen	polyvinyl chloride resin	General Tire & Rubber	pipe, valves, ducts	chemical resistance
whooskey	alcoholic base	———	plasticizing, potting	resists heat and cold
zein	protein (prolamine) from corn	———	coatings, films, fibers	soluble in organic solvents, resists microbiological attack
Zytel	nylon resin	Du Pont	bellows, gears, bearings	high strength, low friction

Note: Names of plastics in italics are *trade names*.

PVC Pipe Plant Opens in NJ

A plant for making polyvinyl chloride pipe and tubing has been constructed by Alpha Plastics, Inc., at Livingston, N. J. Normal and high impact pipe in nominal sizes from ½ to 4 in. is available in 10 and 20-ft lengths. The firm also offers a full line of PVC valves and fittings. Facilities total 12,000 sq ft.

Dressler Becomes Consultant

Russell G. Dressler, formerly manager of chemical engineering research for Southwest Research Institute, has opened consulting offices in San Antonio. He will specialize in these fields: petrochemical process development, coal and lignite utilization, process economic evaluation, reservoir evaporation control, oil and fats technology, patent and expert witness representation in legal matters.

Dr. Dressler

Mr. Dressler holds a B.S. and M.S. in chemical engineering and a Ph.D. in organic chemistry. All were received from the University of Southern California. Among his numerous posts have been supervisor of pilot plant operations for California Research Corp.; head of the Bureau of Mines' gas synthesis plant at Louisiana, Mo.; and technical assistant to the president of Atlas Powder Co.

New Computer Applications Firm

Datics Corp., Fort Worth, Texas, is in the field of computer applications. The range of services offered by Datics covers:

1) Large scale scientific computing.

2) Industrial and commercial data processing.

3) Reduction of scientific and engineering data.

4) Consultation in: a) Equipment specification, for firms considering data processing and computing systems wholly for their own use. b) Personnel training, for companies operating their own computing systems. c) Analysis assistance, reducing technical, scientific, and commercial problems to practical computer applications.

Key personnel of the new organization include:

Kenneth L. Austin, formerly Southwestern regional manager of the ElectroData Corp. His previous experience, primarily in computer applications, includes service with Douglas Aircraft Co. and Consolidated Engineering Co.

Oscar D. Ferris, director of operations, who was formerly with the Magnolia Petroleum Co. as research technologist in the field research laboratories of the production department.

Robert L. McIntire, director of computing services. Mr. McIntire was formerly in the research and development department of Phillips Petroleum Co. He worked first in the pilot plant branch and later organized and became manager of the department's mathematical engineering branch.

Dan W. Patterson, director of data reduction service. He has had several years experience in computer services with the Benson-Lehner Corp. as applications engineer and technical representative.

John M. Ryan, director of data processing, joined Datics after several years with United Gas Corp. as mathematical economist.

Jon Vinson, datatician. He came to the company from the computer program of the United Gas Corp. research laboratory.

Chemico Names Engrg. Director

William J. Rosenbloom has been appointed director of engineering for Chemical Construction Corp. He joined Chemico in 1937 and served as chief engineer for the Canadian affiliate from 1952-55. He has been engaged in the design and start-up of plants in many parts of the world.

Mr. Rosenbloom

Among Mr. Rosenbloom's major contributions to Chemico were the development of the electrolytic hydrogen cell and the atmospheric ammonium sulphate process used in many plants designed by Chemico.

He holds a degree in chemical engineering from McGill University.

Burtis Named Houdry President

Theodore A. Burtis succeeds Chalmer G. Kirkbride as president and board chairman of Houdry Process Corp. He has also been named a director on the board of the Houdry subsidiary, Catalytic Construction Co. Kirkbride has joined Sun Oil Co., but remains a member of the Houdry board.

Mr. Burtis

Mr. Burtis took his B.S. degree in chemical engineering at Carnegie Tech in 1942 and an M.S. in the same subject from Texas A. & M. in 1946. After experience with Magnolia Petroleum Co. and Owens-Corning Fiberglas Co., he joined Houdry as chief of the economics section in the research and development division. That was in 1947, and since then he has served as director of development, supervisor of process engineering, and associate manager of research and development at the Linwood laboratories.

Dever Adds to Responsibilities

Henry F. Dever, president of Brown Instruments Division, now also directs the activities of the parent company, Minneapolis-Honeywell Regulator Co., in the industrial controls field.

He handles overall planning and coordination of the engineering and manufacturing operations of seven M-H divisions now in the field. He continues as president of Brown Instruments, though its daily operations are being directed by C. L. Peterson, vice-president and general manager.

Sittig Joins Lithium Institute

Marshall Sittig, formerly with Ethyl Corp., has become the president and managing director of the Lithium Institute. The Institute is a non-profit organization set up by three major producers of lithium to direct research on problems concerning the industry.

Mr. Sittig

Offices of the Institute are at Princeton, N. J. Mr. Sittig is known for his writings in the petroleum industry and is an authority on the al-

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Suppliers

kali metals. He has been a frequent contributor to PETROLEUM PROCESSING over a number of years.

Beckman Buys Instrument Firm

Beckman Instruments, Inc., has purchased a firm that makes a continuous-action gas chromatograph for the petroleum and chemical industries. Watts Manufacturing Co.'s instrument was developed in cooperation with the special instrumentation department of Carbide and Carbon Chemicals Co. and is being manufactured under license from the parent company, Union Carbide and Carbon Corp.

J. Stuart Watts, founder and president of Watts, will remain on the staff as resident manager of the company's plant, at Ronceverte, W. Va.

Schaffel Is SD Research Director

Gerson S. Schaffel has been named director of research for Scientific Design Co., Inc., New York City. He will head an expanded program of research and development work at the laboratory and pilot plant at Manorhaven, Long Island.

Dr. Schaffel

Dr. Schaffel was director of research for Brea Chemicals before joining Scientific Design. Before that he had held executive positions in chemical research and production with General Tire & Rubber Co.

Personnel Changes

Dow Chemical Co.—Dr. Edgar C. Britton has retired as director of the research laboratory bearing his name but will continue to serve Dow as a research consultant. Succeeding him as lab director is Dr. Ralph P. Perkins, formerly an assistant director.

Colton Chemical Co.—H. W. Strong, Jr., to vice-president in charge of operations.

Expansion, Transition

Brown Fintube Co. has formed a subsidiary, Brown Thermal Development Co., to develop, design, make and sell heat transfer equipment for waste heat recovery, recuperation, and air and gas heating by direct fire. The fired heater division of Brown Fintube will join the new company.

Hydrogen donor-diluent is secret of . . .

Recovering Oil from Sand Deposits

BITUMINOUS sands or tar sands are well known in various parts of the world. One of the most important deposits is in Alberta, Canada, along the Athabasca River and its tributaries. Layers of sand, heavily impregnated with oil, are found over a substantial area in this region.

Typical tar sands or bituminous sands contain 10-16% by weight of a heavy viscous oil or bitumen, but to date, no commercially feasible method of recovery has been developed. Bituminous sands are 84-90% mineral matter, and the oils recovered from them have a high viscosity, and contain large amounts of sulfur and other non-hydrocarbon materials which cause handling problems.

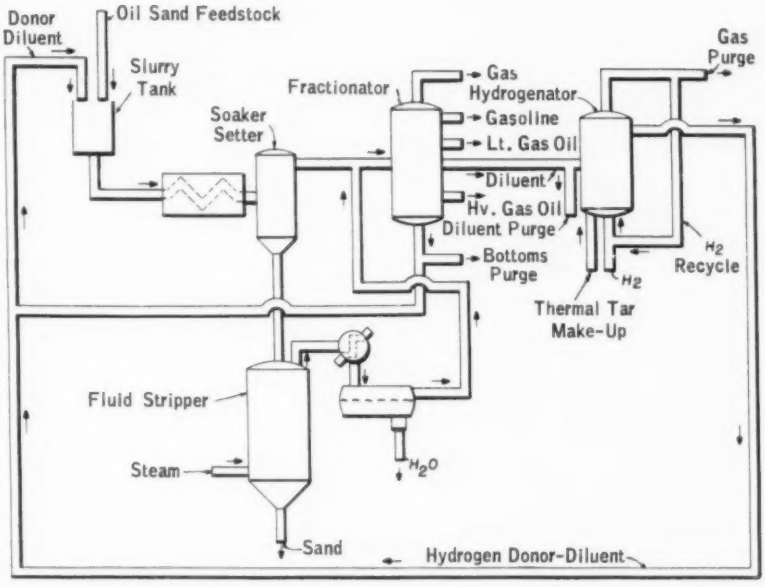
The use of an inexpensive "hydrogen donor-diluent" is described in U. S. Patent 2,772,209, issued to Esso Research & Engr. Co. This hydrogen donor-diluent gives low cost upgrading of the otherwise low grade oils from the sands.

A flow diagram of a typical plant for recovery of oil from bituminous sands is shown above. Feedstock sand is broken up and mixed with the donor-diluent to form a pumpable slurry. The donor-diluent has a boiling range of 500-700°F, and can be a low cost material such as partially hydrogenated thermal tar obtained from catalytic cracking operations.

The slurry is pumped through a fired coil and into a soaking and settling zone where the mixture is heated to about 700-1000°F. The material is held at this temperature from 10-120 minutes to give good extraction.

Transferable hydrogen from the donor-diluent (about 200-600 s.c.f./bbl of diluent) serves to upgrade the oil extracted from the sand. With proper operating conditions, 95% or more of the bitumen can be extracted from the sand.

Extracted material is then fractionated into several cuts, one of which can be partially hydrogenated to serve as the hydrogen donor-diluent for the extraction-hydrogenation step of the process.



LOW COST PROCESS recovers oil from bituminous sands with partial hydrogenation by means of a hydrogen donor-diluent.

About the Patents Listed

The following patents have been selected because of their interest to the petroleum processing industries. Included in this issue are patents from the Official Gazette of the U.S. Patent Office for Nov. 20,27, Vol. 712, Nos. 3,4, and Dec. 4,11, Vol. 713, Nos. 1,2, 1956.

You can obtain copies of patents for 25¢ each by writing directly to the Commissioner of Patents, Washington 25, D.C. Order by patent number.

PROCESSES AND METHODS

FOR . . .	OF . . .	WITH . . .	ASSIGNEE . . .	PATENT . . .
Alkylation	isoparaffin & olefin	recovery of hydrogen fluoride cat.	Phillips Petroleum Co.	2,773,920
Breaking	petroleum emulsions	phenol-aldehyde resins	Petrolite Corp.	2,771,425-455
Catalytic cracking	hydrocarbons	H_2 donor dilu. & non-cat. crack.	Esso Research & Engrg. Co.	2,772,213-4, 8, 221-2

(Continued on p. 138)

Patents (continued)

FOR . . .	OF . . .	WITH . . .	ASSIGNEE . . .	PATENT NO. . . .
Catalytic reforming	gasolines	plurality of zones & severities	Socony Mobil Oil Co., Inc.	2,772,216
	hvy. naphtha	partial hydrogenation of feed	Esso Research & Engrg. Co.	2,772,215
	high sulfur naphtha	hydrofining of feedstock	Standard Oil Co. (Ind.)	2,773,013
	naphthas	catalyst regeneration system	Standard Oil Co. (Ind.)	2,772,014
	naphthas	fluidized-solids reactor	Esso Research & Engrg. Co.	2,773,015
	naphthas	fluidized-solids technique	Esso Research & Engrg. Co.	2,772,217
	naphthas	oxidation-inhibited feed	Esso Research & Engrg. Co.	2,772,220
	naphthas	sep. reac. for hi & lo boilers	Universal Oil Products Co.	2,773,809
	naphthas	2-stage, fluidized hydroforming	Esso Research & Engrg. Co.	2,773,808
Coking	hvy. residuals	recycled hot coke solids	Esso Research & Engrg. Co.	2,773,811
Concentration	benzene hexachloride	ethylene glycol extraction	Ethyl Corp.	2,773,102
Control	water pH	contin. aq. acid soln. addition	Sinclair Refg. Co.	2,772,779
Conversion	C_9 aromatics	HF-BF_3 giving 1-,3-dimethyl, 5-ethyl benzene	Standard Oil Co. (Ind.)	2,773,916
	gaseous reactants	moving mass of gran. contact mat'l.	Socony Mobil Oil Co., Inc.	2,773,016
	hydrocarbons	hydrofining & reforming	Standard Oil Co. (Ind.)	2,773,008
	hydrocarbons	hydrofining & reforming	Universal Oil Products Co.	2,773,007
	naphthas	hydroform. & hydrodesulf. with same cat.	Esso Research & Engrg. Co.	2,773,804
Decolorization	mineral oils	palpable particulate adsorbent	Socony Mobil Oil Co., Inc.	2,771,407
Degasification	oils	heating & separation	Phillips Petroleum Co.	2,773,559
Degumming	hydrocarbons	alkali & alkiline earth metals	Ethyl Corp.	2,772,211
Dehydroalkylation	unsat. cyclic cmpd.	aliphatic olefin reaction	Universal Oil Products Co.	2,771,495
Dehydrogenation	hydrocarbons	sulfur dioxide	Socony Mobil Oil Co., Inc.	2,772,315
Dehydration	LPG	silica gel	Standard Oil Co. (Ind.)	2,772,208
Demethylation	CH_3-sub. benzenes	chromia-alumina cat.	Socony Mobil Oil Co., Inc.	2,773,917
Densification	ink-carbon blacks	tumbling & pressing apparatus	Godfrey L. Cabot, Inc.	2,771,347
Determination	metal ions	direct reading polarograph	Standard Oil Co. (Ind.)	2,773,020
Dewaxing	oils	solvent & crystallization	Esso Research & Engrg. Co.	2,772,210
Dimerization	conjugated polyene	alkali metal	Ethyl Corp.	2,773,092
Disproportionation	ethylbenzene	liq. HF-BF_3 agent	Standard Oil Co. (Ind.)	2,773,109
Ethylation	aromatics	acidic catalyst	Standard Oil Co. (Ind.)	2,773,108
Feeding	liq. reactants	temperature control	Socony Mobil Oil Co., Inc.	2,771,406
Generation	synthesis gas	hydrocarbon gas-oxygen reaction	Hydrocarbon Research, Inc.	2,772,149
Hydrodesulfurization	crudes	2-stage, dehydrog., hydrog.	Esso Research & Engrg. Co.	2,771,401
	benzole motor fuels	Co-Mo-alumina cat.	British Petroleum Co. Ltd.	2,771,400
Hydrogenation	aldehydes	production of alcohols	Esso Research & Engrg. Co.	2,771,493
	carbon monoxide	precipitated iron cat.	Ruhrchemie AG & Lurgi G.	2,773,890
	carbon monoxide	production of oxygenous cmpds.	Ruhrchemie AG	2,773,084-5
Improvement	lube color	potassium hydroxide & products	Standard Oil Co. (Ohio)	2,773,034
	Cu corrosivity	alkanolamine treat, of doctor sweet. oil	Standard Oil Co. (Ind.)	2,771,405
Manufacture	alcohol	olefin hydration & corros. prevent.	Eastman Kodak Co.	2,773,910
	alkyl aryls	condensation reaction	Universal Oil Products Co.	2,771,496
	alkyl aryl sulfonates	alkylation-sulfonation of aromatics	James W. Putt	2,773,896
	bicyclic cmpd.	epoxidizing agent	Universal Oil Products Co.	2,771,470
	carboxylic acid	tertiary alkyl-sub. cyclohexane	Shell Development Co.	2,771,487-8
	carbon black	thermal process	Godfrey L. Cabot, Inc.	2,773,744
	catalyst	chromia-alumina cogel	Socony Mobil Oil Co., Inc.	2,773,845-6
	catalyst	increased surface & pore volume	Esso Research & Engrg. Co.	2,773,843
	catalyst	alumina-chromia-phos. pentoxide cogel	Socony Mobil Oil Co., Inc.	2,773,837
	catalyst	silica-alumina or magnesia base	Esso Research & Engrg. Co.	2,773,841
	catalyst	oxide-promoted titanium-phosphorous	Standard Oil Co. (Ind.)	2,773,836
	metal hydroxides	platinum & palladium salts	The Atlantic Refg. Co.	2,773,742
	copolymers	monomers & propenylbenzene	Ethyl Corp.	2,773,052
	dibasic acids	mitric acid oxid. of hydrocarbons	Gulf Research & Development Co.	2,771,482
	dicarboxylic acid anhydrides	catalytic oxidation of non-aromatics	The Atlantic Refg. Co.	2,773,838
	electrode binder	carbonaceous mat'l.	Esso Research & Engrg. Co.	2,772,219
	epoxy esters	arom. cmpds. & unsub. hydrocarbon carboxylic acid	Shell Development Co.	2,772,296
	ethylene oxid. cat.	silver supported on inert carrier	Shell Development Co.	2,773,844
	glycerine	allyl alcohol-H_2O_2 react.	Shell Development Co.	2,773,909
	gran. NH_4NO_3	predetermined particle size	Commercial Solvents Corp.	2,773,753
	hexachlorobenzene	chlorine-benzene hexachloride react.	Ethyl Corp.	2,773,104
	H_2 & CO	cat. combustion of liq. fuels	Montecatini	2,772,955
	hydroforming cat.	treatment of hydrous Al_2O_3	Esso Research & Engrg. Co.	2,773,842
	hydrogel	oxides of aluminam & chromium	Socony Mobil Oil Co., Inc.	2,773,839
	monocarboxylic acid diester	pyrolyzation of trihydroxyalkane triester	Shell Development Co.	2,773,895
	nitrobenzene	contin. react. of HNO_3, H_2SO_4, & C_6H_6	du Pont Co.	2,773,911
	odorless naphtha	dihydric & trihydric alco. solvent	Pure Oil Co.	2,773,919
	oxidation inhibitor	use in oxidation resistant lube oil	Esso Research & Engrg. Co.	2,773,005
	polymer grease	therm. stab. organic-silicone	Standard Oil Co. (Ind.)	2,771,422

(Continued on p. 140)

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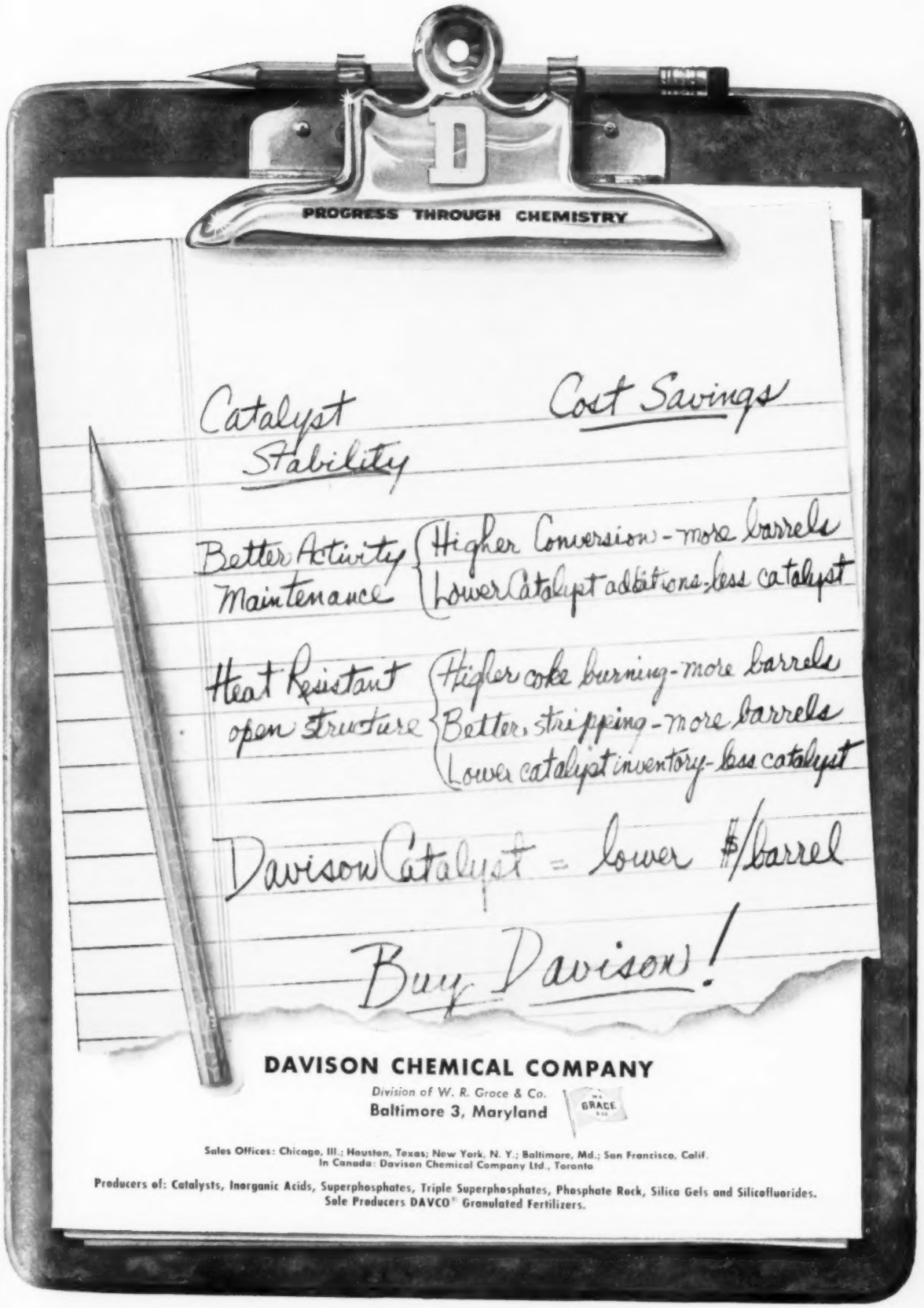
Patents (continued)

FOR . . .	OF . . .	WITH . . .	ASSIGNEE . . .	PATENT NO. . . .
Manufacture (continued)	pour point depressant	chloromethylated syn. still bottoms-diwax benzene react.	Continental Oil Co.	2,773,915
	phthalonitrile	NH_3-isothalic acid (or terephthalic acid)	California Research Corp.	2,773,891
	resins	cracked C_5 & cyclopentadiene dimer polymer	Esso Research & Engrg. Co.	2,773,051
	rubbery polymers	admixture in lube oils	Esso Research & Engrg. Co.	2,771,458
	solid resin	butadiene-styrene copolymer	Esso Research & Engrg. Co.	2,772,254
	synthetic cmpds.	catalytic hydrogenation of CO	Ruhrchemie AG & Lurgi G.	2,771,481
	synthetic rubber	isoolefin-aliph. diolefin copoly.	Esso Research & Engrg. Co.	2,772,255
	synthesis gas	part. combust. of gas hydrocarbons	Koppers Co., Inc.	2,773,756
	trichlorobenzene	dehydrochlor. of benzene hexachlor.	Ethyl Corp.	2,773,105
	xylylene dimine	hydrog. of phthalonitrile dinitrile	California Research Corp.	2,773,902
Odor stabilizing	mineral oils	alkylation, fractionation, H_2SO_4 & alkali wash	Esso Research & Engrg. Co.	2,772,316
Operation	pebble heaters	movement thru thermal process zone	Metallgesellschaft AG	2,772,873
Oxidation	xylene & toluic acid	alkanol & free O_2-containing gas	California Research Corp.	2,772,305
Polymerization	ethylene	Group VA metal pentoxide	Standard Oil Co. (Ind.)	2,773,053
	gaseous olefins	cat. of oxalic acid on siliceous adsorbent	Esso Research & Engrg. Co.	2,722,317
Preparation	lube oil	adsorption & dewaxing process	Sun Oil Co.	2,733,803
Prevention	H_2S evolution	phosphorus S-O-contain. cmpds.	Standard Oil Co. (Ohio)	2,773,860-2
Purification	paraffin hydrocarbons	catalytic hydrogenation	Ruhrchemie AG	2,773,110
	isobutylene	H_2SO_4 removal of ethyl mercaptan	Esso Research & Engrg. Co.	2,771,497
Recovery	acetylene cmpds.	absorption in alkyl ether of diethylene glycol	Fluor Corp.	2,773,560
	acyclic diene dimers	thermal soaking & fractionation	Esso Research & Engrg. Co.	2,773,106
	aromatics	separation from HF-BF_3 agent	Standard Oil Co. (Ind.)	2,773,107
	asphalt resins	solvent absorption system	Sinclair Refg. Co.	2,773,004
	elemental sulfur	silica gel adsorp. of sulf. diaryl alkane	Phillips Petroleum Co.	2,771,465
	elemental sulfur	recovery of H_2S from gases	Heinz Pippig	2,772,146
	ethylene oxide	absorption in aqueous solvent	Shell Development Co.	2,771,473
	free hydrogen	silver-palladium permeable film	Atlantic Refg. Co.	2,773,561
	gas liquids	refractive index control	Phillips Petroleum Co.	2,771,149
	hydrogen sulfide	adsorption from natural gas	Jefferson Lake Sulphur Co.	2,771,964
	naphthenes	absorption in 2-tyrrolidone	Phillips Petroleum Co.	2,771,494
Reduction	fracturing	ion-exchange resin treating liqs.	Socony Mobil Oil Co. Inc.	2,772,236
Refining	crude oils	integrated hvy. oil process	Esso Research & Engrg. Co.	2,773,017
	light distillates	formaldehyde & alkali metal	Esso Research & Engrg. Co.	2,773,805
	lube oils	eutectic mix. of NaOH & KOH	Esso Research & Engrg. Co.	2,773,807
	petroleum vapors	alkali metal hydroxide	Sun Oil Co.	2,773,806
Regeneration	H_2S absorbent	oxidizing gas	Standard Oil Co. (Ind.)	2,772,945
	used alkaline	epoxy cmpd. treatment	Sun Oil Co.	2,771,404
Removal	nitrogen cmpds.	hydrogen treat. of hydrocarbons	Universal Oil Products Co.	2,773,011
	water in polymers	heated rolls	Standard Oil Co. (Ind.)	2,771,689
Segregation	hydrocarbons	separation of aromatics and non-aromatics	Union Oil Co. of Calif.	2,773,006
Separation	aromatics	solvent extraction process	Universal Oil Products Co.	2,773,918
	catalyst fines	moving-bed conversion systems	Socony Mobil Oil Co., Inc.	2,772,223
	mercaptans	aq. soln. of triethanolamine & sol. Pb.	Standard Oil Co. (Ind.)	2,773,905
	oil	extraction from bituminous sands	Esso Research & Engrg. Co.	2,772,209
Stabilization	oxidative mat'ls.	various oxy-organic cmpds.	Universal Oil Products	2,771,349; 367-8
Sweetening	sour distillates	Doctor treatment	Standard Oil Co. (Ind.)	2,733,010
	sour cracked naphthas	air-caustic treatment	Standard Oil Co. (Ind.)	2,771,403
	sour hydrocarbons	controlled hypochlorite process	Esso Research & Engrg. Co.	2,773,009 & 019
Treatment	gas oils	hypochlorite soln., MeOH & caust. alk.	British Petroleum Co. Ltd.	2,771,402
	waste water	stripping gas	Universal Oil Products Co.	2,773,003
Upgrading	petroleum crudes	metals removal & hydrodesulf.	Esso Research & Engrg. Co.	2,722,212
Washing	spent adsorbent	liq. solvent	Socony Mobil Oil Co., Inc.	2,771,408

PRODUCTS

Catalyst	Zn-Al-oxide complex	hydroforming catalyst component	Esso Research & Engrg. Co.	2,773,810
	V_2O_5-P_2O_5	olefin conversion properties	Standard Oil Co. (Ind.)	2,773,921
Coating mat'l	asphalt	polyamine reaction product	Standard Oil Co. (Ind.)	2,772,179
Copolymer	dimethyl itaconate	diolefin & basic amine radicals	Esso Research & Engrg. Co.	2,771,459
Detergent mat'l.	alkyl aryl sulfonate	non-caking, solid, particulate form	California Research Corp.	2,773,833
	organic detergent	foam-improving agent	California Research Corp.	2,772,239
Foam inhibitor	lube oil	alkylphenol polyethyleneglycol ether sulfide	California Research Corp.	2,772,238
Lubricant	lube oil	anticorrosion additive	Phillips Petroleum Co.	2,773,038
	lube oil	antioxidant, anticorrosion additive	Tidewater Oil Co.	2,773,037

(Continued on p. 142)



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(To obtain more data on advertised products see page 154)

Patents (continued)

FOR . . .	OF . . .	WITH . . .	ASSIGNEE . . .	PATENT . . .
Lubricant (continued)	lube oil	copper-polymer stability additive	Standard Oil Co. (Ohio)	2,773,033
	lube oil	hexachlorocyclopentadiene-thio	Standard Oil Co. (Ind.)	2,773,832
Metal working oil	mineral oil	diester of chlorindic acid	Sinclair Refining Co.	2,771,423
Rubber	copolymer	butadiene-styrene & plasticizer	Atlantic Refg. Co.	2,773,854
Soluble lubricant	lube oil	soluble soap emulsifying agent	Tidewater Oil Co.	2,773,035-6
Stable, cracked dist.	high boiling fract.	iodine-amine inhibitor	Standard Oil Co. (Ind.)	2,771,348
Wax composition	paraffin wax	microcrystalline wax & lube oil	Sun Oil Co.	2,773,812

EQUIPMENT

Calibration	flowmeters	insertable, movable seal plug	Shell Development Co.	2,772,561
Contacting	fluids	entrainment & inertia separation	Shell Development Co.	2,772,748
	gases-liquids	plate with perforations & loose covers	Koch Engrg. Co., Inc.	2,772,080
	liquids-solids	continuous percolation	Socony Mobil Oil Co., Inc.	2,772,780 & 2,773,012
Control	fuel flow	infra-red apparatus	Shell Development Co.	2,773,349
	fluid solids	upward flow in parallel tubes	Standard Oil Co. (Ind.)	2,772,076
Dispensing	liquids	constant flow rate control	Union Oil Co. of Calif.	2,771,228
Elevation	gran. mat'l.	pneumatic lift	Socony Mobil Oil Co., Inc.	2,772,123
Exchange	heat	vertical pebble-filled vessel	Phillips Petroleum Co.	2,772,122
Fractionation	vapors-liquids	perforated plates	Esso Research & Engrg. Co.	2,772,081
Indication	liquid level	high-mu ferromagnetic torroidal float	United States of America	2,773,386
Manufacture	heat exchangers	longitudinal bonding groove	John Karmazin	2,773,301
	hydrogel beads	vertical liq. chamber apparatus	Socony Mobil Oil Co., Inc.	2,773,840
Measurement	fluid flow	free piston in measuring cylinder	Esso Research & Engrg. Co.	2,772,664
	viscosity	continuous viscometer	Shell Development Co.	2,771,770
Protection	vessel walls	prevention of solid particle erosion	Shell Development Co.	2,772,925
Sampling	fluid catalyst	sampling & eductor tube system	American Oil Co.	2,771,776
Thermal diffusion	liquids	elongated separation chambers	Standard Oil Co. (Ohio)	2,772,782
Transfer	gran. solids	moving method for solid cat.	Socony Mobil Oil Co., Inc.	2,772,224-5

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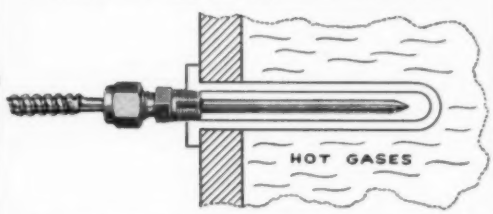
With T-E's *Ceramo*® Construction



For measuring all types of process temperatures, T-E's "Ceramo" construction—ceramic insulation, metal sheathing—provides a tremendous increase in thermocouple life over conventional, open-end types. In a typical application, enclosed hot junction, ⅛" O.D. "Ceramo" thermocouples were used recently in a hydro carbon cracking unit operating continuously at 1616° F. "Ceramo" thermocouples lasted 7 to 9 months—*while 14 gage bare wire thermocouples lasted but 2 to 14 days.* And there was no significant difference in response. "Ceramo" thermocouples are available in all standard calibrations. Overall diameters—1/25" to 7/16"

Write for Bulletin 325-I

Thermo Electric Co. Inc.

SADDLE BROOK, NEW JERSEY

In Canada—THERMO ELECTRIC (Canada) Ltd., Brampton, Ont.

Atoms in Industry a Topic at Congress

WHAT atomic energy can do for industry will be discussed in one phase of the 1957 Nuclear Congress, to be held in Philadelphia's Convention Hall from March 11 to 15. The Congress is broken into several smaller conferences, which will be held at different times during the five-day period. The section of greatest interest to the petroleum industry, the 5th Atomic Energy in Industry Conference, will be held on March 14 and 15.

Here are some of the subjects this conference will consider:

"How to Develop Better Products Through Radioisotopes"

"Reactor Hazards, Public Safety and Insurance"

"Atomic Age Metals Create New Markets"

"New Products Through Radiation Chemistry"

"Atomic Energy Legislation"

"Chemical Processing and Waste Disposal"

"Long Range Outlook for Nuclear Industries"

"Safety and Health Problems"

The Congress will include the 3rd International Atomic Exposition, in which major suppliers and service organizations to the nuclear energy field will display their wares. The 5th Hot Laboratories and Equipment Conference, March 14-15, will cover new developments in "hot cells" and labs and remote handling equipment. It will also have a discussion of atomic research lab construction and management. The 2nd Nuclear Engineering and Science Conference, March 11-14, will take up the technical problems of producing atomic energy. Thermodynamics, coolant systems, shielding, reactor design, etc., will be discussed.

ASQC to Teach Box Method In Houston, Feb. 13-15

A course in the Box method of experimentation will be sponsored for the third time by the American Society for Quality Control, Feb. 13-15, at the Lamar Hotel, Houston.

The society gave the course twice in 1956, and the instruction this time will be in the hands of the same person as then, Dr. J. S. Hunter, of the American Cyanamid Co. C. T. Shewell, Humble Oil & Refining Co., Baytown, is chairman of the committee on arrangements.

The Box method of experimentation offers a way of increasing the return from a given amount of research effort. Essentially, it yields, by means of strategically placed experiments, the data needed to describe a process (chemical or other) in quantitative terms and to select the right combination of variables for the optimum result. It was named after G. E. P. Box, of Imperial Chemical Industries.

Cuba Plans Oil Congress In Havana, May 5-11

Oil processing, research, training, and management will be among the topics taken up at the 2nd Cuban Congress on Petroleum. The event will be held in Havana from May 5 to 11. Papers are being planned that will treat these topics in a general way, not necessarily dealing with the new oil industry in Cuba.

The program committee is being headed by Paul J. Griffiths, vice-president and director of White Eagle International Oil Co. in Cuba. Papers should be submitted by March 1.

Oil Man's Calendar

(Boldface items reviewed in this issue)

FEBRUARY

4-8 American Society for Testing Materials, committee week, Franklin Hotel, Cleveland

7-8 Western Petroleum Refiners Assn., technical-industrial relations meeting, Gulf Coast region, Lamar Hotel, Houston

8-9 Symposium on Composition of Petroleum Oils, API and ASTM subgroup, Jung Hotel, New Orleans

13-15 Box Method of Experimentation, course sponsored by American Society for Quality Control, Lamar Hotel, Houston

14-16 American Assn. of Cost Engineers, winter meeting, New York City

15-16 National Society for Professional Engineers, spring meeting, Hotel Francis Marion, Charleston, S. C.

22 Natural Gasoline Assn. of America, Permian Basin regional, Scharbauer Hotel, Midland, Texas

MARCH

3-6 American Institute of Chemical Engineers, national, Greenbrier Hotel, White Sulphur Springs, W. Va.

11-15 Nuclear Congress, Engineers Joint Council, etc., Convention Hall, Philadelphia

11-13 Chemical Institute of Canada, Divisional Conference on Chemical Engineering, Kingston, Ont.

11-15 National Assn. of Corrosion Engineers, annual, Kiel Auditorium, St. Louis, Mo.

18-21 Society of the Plastics Industry, annual, Los Angeles-Biltmore Hotel, Los Angeles

18-21 Gas Turbine Power Conference, ASME, Sheraton-Cadillac, Detroit

25-27 Western Petroleum Refiners Assn., annual, Hilton Plaza Hotel, San Antonio

27-28 Engineering Management Conference, ASME, Penn Hotel, Pittsburgh

APRIL

3-5 Corrosion Control Short Course, Central Oklahoma Section of the NACE and University of Oklahoma, Extension Study Center, Norman, Okla.

7-12 American Chemical Society, national, Miami

8-10 American Society of Mechanical Engineers, spring meeting, Dinkler-Tutwiler Hotel, Birmingham, Ala.

9-11 5th Welding Show, American Welding Society, Philadelphia

10-12 National Nuclear Instrumentation Conference, Instrument Society of America, Atlanta, Ga.

16-18 National Petroleum Assn., semi-annual, Hotel Cleveland, Cleveland

16-18 Southwestern Gas Measurement Short Course, U. of Oklahoma, Norman

24-26 Natural Gasoline Assn. of America, annual, Rice Hotel, Houston

29-30 Automatic Control in the Petroleum and Chemical Industries, conference by U. of Oklahoma, Norman

29-May 3 7th Materials Handling Exposition, Convention Hall, Philadelphia

MAY

5-11 Cuban Congress on Petroleum, Havana

13-15 Industrial Waste Conference, Purdue University, Lafayette, Ind.

13-16 American Petroleum Institute, Division of Refining mid-year meeting, Sheraton Hotel, Philadelphia

JUNE

2-7 Society of Automotive Engineers, summer meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

3-5 Chemical Institute of Canada, annual, Vancouver, B. C.

5-7 Pennsylvania Grade Crude Oil Assn., annual, Penn-Sheraton, Pittsburgh

9-12 American Institute of Chemical Engineers, national, Olympic Hotel, Seattle, Wash.

9-13 American Society of Mechanical Engineers, semiannual, Sheraton Palace Hotel, San Francisco

11-13 Western Plant Maintenance and Engineering Show, San Francisco

16-18 American Society for Testing Materials, annual, Chalfonte-Haddon Hall, Atlantic City

This Controller requires no more attention than a weathervane!

Like a weathervane, the Foxboro M/59 Consotrol Controller can be installed completely exposed to the elements . . . and forgotten about! Unsurpassed in performance by any other flow controller, the M/59 is *completely indifferent to weather conditions.*

This rugged Flow Controller mounts directly on the air connection of the valve . . . at a fraction of usual installation cost. Its case is tightly gasketed, continuously purged, completely weatherproof, highly resistant to dust, fumes, and vibration. There's nothing to align, nothing to wear out. A flexure-strip fulcrum eliminates the friction and wear of conventional pivots . . . eliminates "conventional" maintenance.

In operation, the M/59 fully utilizes the speed and sensitivity of the Foxboro d/p Cell Flow Transmitter . . . does away with transmission lag . . . gives fastest recovery from process upsets. For the *complete* story, write today for Bulletin 470.

"Live-Balance" Control on any fluid with any size valve motor.

Lowest first cost. Lowest installed cost.

Lowest maintenance cost.

Unique Simplicity — exclusive design permits fixed, optimum proportioning and reset values for liquid flows. Adjustable reset optional for gas or steam flow.

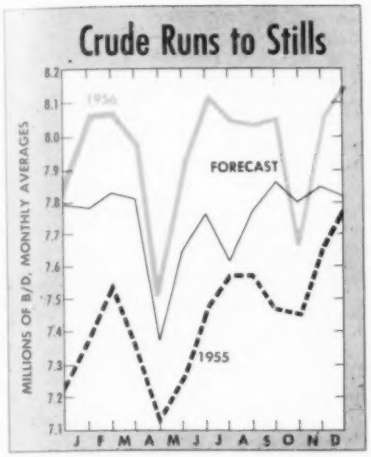
THE FOXBORO COMPANY, 912 NEPONSET AVENUE, FOXBORO, MASS., U.S.A.

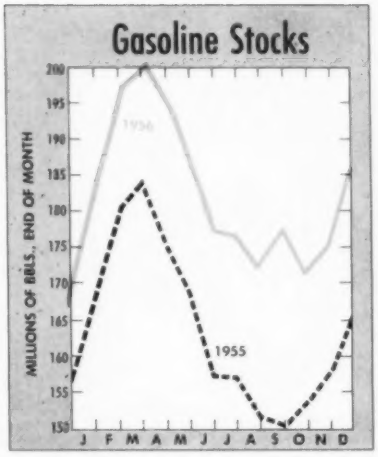
FOXBORO
REG. U. S. PAT. OFF.

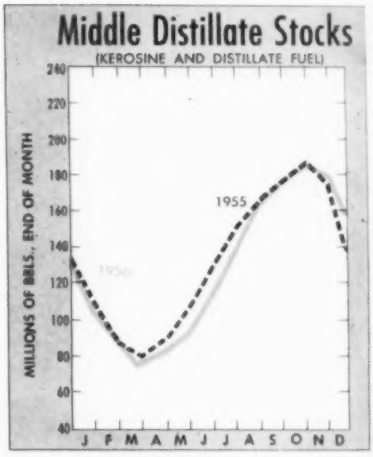
FLUID FLOW CONTROLLERS

FACTORIES IN THE UNITED STATES, CANADA AND ENGLAND

(To obtain more data on advertised products see page 154)







Runs High for Total Needs

IN THE early stages of the emergency export program brought about by the Middle East crisis, U. S. refiners were operating at a rate that met these needs and seasonal domestic demands without abnormal withdrawals from product stocks. In fact, the net withdrawals from product stocks in refiners' hands were less than for the same period a year ago.

For the 7-week period from Nov. 1 - Dec. 19, total emergency shipments from the U.S. Gulf Coast to the Eastern Seaboard and to Western Europe averaged 345,000 b/d. Shipments to the Eastern Seaboard replace Middle East crude oil receipts. Of the total, 114,000 b/d were crude oil and 231,000 b/d products, principally distillate and residual fuel, and gasoline.

OUTLOOK: For refiners' gasoline stocks for the U.S., to reach 210,000,000 bbl by March 31. On March 31, 1956 they were about 200,000,000 bbl.

For this 7-week period, U.S. refiners ran an average of 8,010,000 b/d of crude to their stills, 4% greater than the 7,698,000 b/d processed in the comparable period of 1955.

In these weeks in 1956, distillate fuel oil stocks for the U.S. were reduced 23,705,000 bbl, from 158,685,000 bbl Nov. 2 to 134,908,000 bbl Dec. 21. In 1955, these inventories were reduced 34,034,000 bbl, from 151,988,000 bbl Nov. 4 to 117,954,000 bbl Dec. 23. The reason for the lower withdrawals this season was the warm December, which held down distributors' buying. On January 4, 1957, distillate fuel oil stocks for the U.S. were 132,942,000 bbl, 25,673,000 bbl higher than on Jan. 6, 1956, a sizeable surplus for this late in the wholesale heating oil buying season, even though some of these inventories are earmarked for later shipment to Europe.

In the 7 weeks from Nov. 2 to Dec. 21, 1956, total U.S. gasoline inventories built up 7,917,000 bbl compared with an increase of 9,737,000 bbl in the comparable weeks in 1955. These stocks Jan. 4, were 186,808,000 bbl, 17,796,000 bbl larger than inventories of 169,012,000 bbl Jan. 6, 1956, which were considered topheavy for supply-demand needs.

DECEMBER KEY STATISTICS

(Figures given in terms of millions of b/d, monthly averages, except stocks, which are in millions of bbl at end of month)

	Dec. 1956	Nov. 1956	Dec. 1955
CRUDE OIL			
U. S. Production	7.373	7.124	7.155
Imports	.856	.845	.884
U. S. Stocks	263.025	275.906	265.610
Runs to Stills	8.101	8.026	7.762
GASOLINE			
Refinery Output	3.954	3.822	3.846
Refinery Demand	3.715	3.823	3.718
Primary Stocks	186.230	175.401	165.433
MIDDLE DISTILLATES			
Refinery Output	2.367	2.195	2.151
Refinery Demand	3.094	2.369	3.373
Primary Stocks	165.549	188.093	138.103
RESIDUALS			
Refinery Output	1.236	1.181	1.286
Imports & Other	.615	.451	.596
Total Supply	1.851	1.632	1.882
Refinery Demand	1.906	1.749	2.041
Primary Stocks	42.685	44.389	39.174

PRODUCT AND CRUDE PRICES

(Products—¢ gal, weighted average prices in principal refinery markets
Crudes—$/bbl, principal fields
Source—Platt's Oilgram Price Service)

	Dec. 1956	Nov. 1956	Dec. 1955
Gasoline (regular)	11.98	11.80	11.81
Distillate Fuel Oil	9.69	9.49	9.11
Kerosine	11.22	11.08	10.51
Residuals	6.00	5.51	4.96
Above 4 Products	9.80	9.53	9.29
Lube Oils	22.86	22.86	20.44
Crude	2.88	2.86	2.83

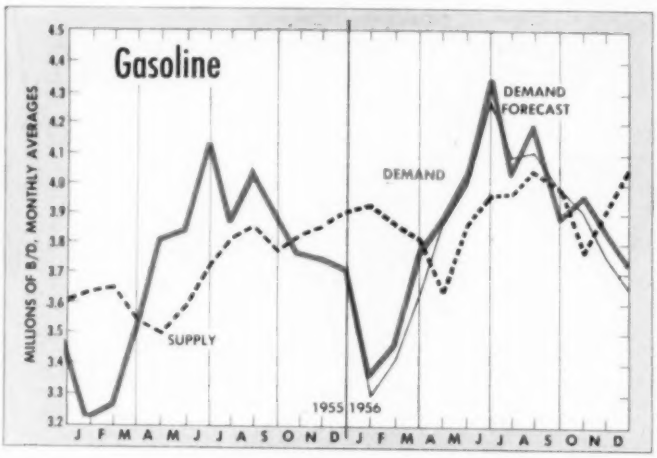
REFINERY YIELDS

% on Crude Runs to Stills

	Dec. 1956	Nov. 1956	Dec. 1955
Gasoline	44.1	43.1	43.9
Kerosine	4.7	4.7	5.0
Distillate	24.5	22.7	22.3
Residuals	15.3	14.7	16.2

SOURCE OF DATA (Except prices): Nov. and Dec., API weekly reports; earlier months, Bureau of Mines

Gasoline Demand Continues to Level Off

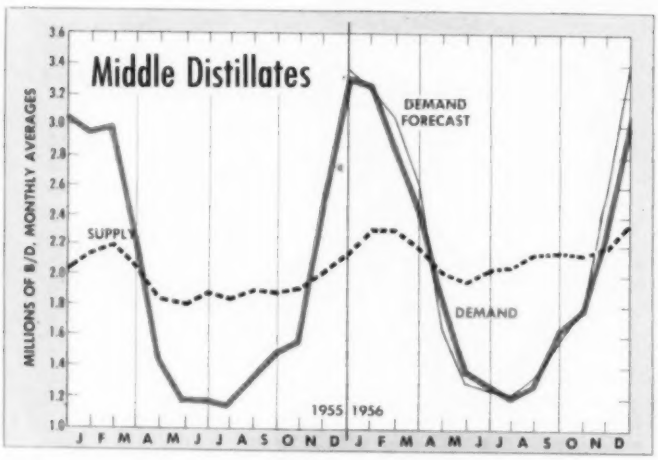


MOTOR FUEL

	From Crude	From Nat. Gas	Total
SUPPLY (Millions of b/d)			
Dec. '56	3.570	.494	4.064
Dec. '55	3.476	.479	3.955*
Change	+ .094	+ .015	+ .109
% Change	+ 2.7	+ 3.1	+ 2.8
DEMAND (Including Exports) (Millions of b/d)			
Dec. '56			3.715
Dec. '55			3.718*
Change			— .003
% Change			—0—
TOTAL SUPPLY (Millions of bbl)			
12 Mos. '56	1,263.708	166.519	1,430.227
12 Mos. '55	1,205.146	168.804	1,373.950*
Change	+ 58.562	— 2.285	+ 56.277
% Change	+ 4.9	— 1.3	+ 4.1
TOTAL DEMAND (Including Exports) (Millions of bbl)			
12 Mos. '56			1,414.269
12 Mos. '55			1,368.726*
Change			+ 45.543
% Change			+ 3.3

*Bureau of Mines figures have been revised upward.

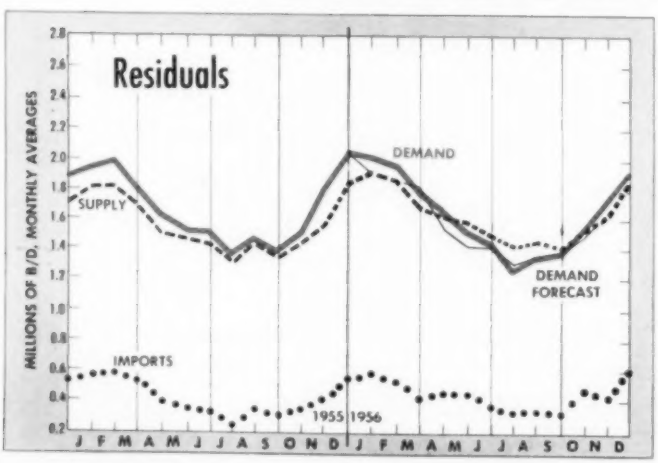
December Distillate Demand Below Year Ago


Middle Distillates
DEMAND FORECAST
SUPPLY
DEMAND
MILLIONS OF B/D. MONTHLY AVERAGES
1955 1956
J F M A M J J A S O N D J F M A M J J A S O N D

MIDDLE DISTILLATES

	Kerosine	Dist. Fuel Oil	Total
PRODUCTION (Millions of b/d)			
Dec. '56	.383	1.984	2.367
Dec. '55	.388	1.763	2.151
Change	— .005	+ .221	+ .216
% Change	— 1.3	+ 12.5	+ 10.0
DEMAND (Including Exports) (Million of b/d)			
Dec. '56	.482	2.612	3.094
Dec. '55	.605	2.768	3.373
Change	— .123	— .156	— .279
% Change	— 20.4	— 5.6	— 8.3
TOTAL PRODUCTION (Millions of bbl)			
12 Mos. '56	123.390	665.103	788.493
12 Mos. '55	117.137	602.547	719.684
Change	+ 6.253	+ 62.556	+ 68.809
% Change	+ 5.3	+ 10.4	+ 9.6
TOTAL DEMAND (Including Exports) (Millions of bbl)			
12 Mos. '56	119.535	648.030	767.565
12 Mos. '55	120.143	605.733	725.876
Change	— .608	+ 42.297	+ 41.689
% Change	— 0.5	+ 7.0	+ 5.7

Residual Supply & Demand Up Seasonally


Residuals
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MILLIONS OF B/D. MONTHLY AVERAGES
1955 1956
J F M A M J J A S O N D J F M A M J J A S O N D

RESIDUAL FUELS

	Refinery Output	Imports & Other	Total
SUPPLY (Millions of b/d)			
Dec. '56	1.236	.615	1.851
Dec. '55	1.286	.596	1.882
Change	— .050	+ .019	— .031
% Change	— 3.9	+ 3.2	— 1.6
DEMAND (Including Exports (Millions of b/d)			
Dec. '56			1.906
Dec. '55			2.041
Change			— .135
% Change			— 6.6
TOTAL SUPPLY (Millions of bbl)			
12 Mos. '56	425.052	169.145	594.197
12 Mos. '55	420.331	157.594	577.925
Change	+ 4.721	+ 11.551	+ 16.272
% Change	+ 1.1	+ 7.3	+ 2.8
TOTAL DEMAND (Including Exports) (Millions of bbl)			
12 Mos. '56			590.186
12 Mos. '55			590.856
Change			— .670
% Change			— 0.1

SOURCE OF DATA: Nov. and Dec., API weekly reports; earlier months, Bureau of Mines (1956 figures for 366 days)

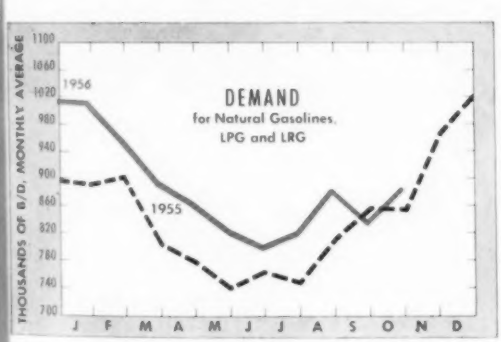
RUNS TO STILLS AND DISTRIBUTION OF PRIMARY STOCKS BY U. S. REFINERY DISTRICTS

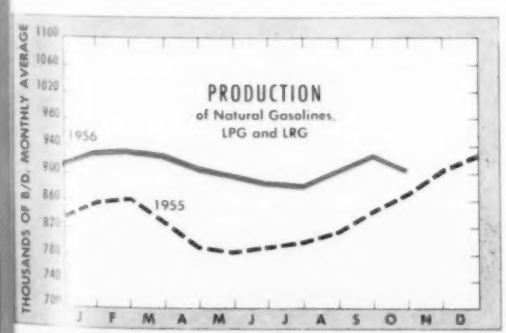
(Primary stocks include those at refineries, at large terminals and in pipelines; all data based on API reports)

District	RUNS TO STILLS (Millions of b/d average for week ending on date shown) Dec. 28 1956	Dec. 30 1955	Change	% Change	GASOLINE STOCKS (Millions of bbl on date shown) Dec. 28 1956	Dec. 30 1955	Change	% Change	RESIDUAL STOCKS (Millions of bbl on date shown) Dec. 28 1956	Dec. 30 1955	Change	% Change
East Coast	1.207	1.095	+ .112	+10.2	40.994	35.724	+ 5.270	+14.8	11.585	11.497	+ .088	+ 0.8
Gulf Coast	2.733	2.654	+ .079	+ 3.0	38.369	32.313	+ 6.056	+18.7	7.779	8.106	— .327	— 4.0
Total Coastal	3.940	3.749	+ .191	+ 5.1	79.363	68.037	+11.326	+16.6	19.364	19.603	— .239	— 1.2
Appalachian	.214	.214	—	—	7.910	6.990	+ .920	+13.2	.655	.815	— .160	—19.6
Ind.-Ill.-Ky.	1.577	1.514	+ .063	+ 4.2	36.108	34.179	+ 1.929	+ 5.6	5.626	3.778	+ 1.848	+49.0
Okla.-Kans.-Mo.	.764	.761	+ .003	+ 0.4	20.195	17.614	+ 2.581	+14.7	1.596	1.335	+ .261	+19.6
Other Inland	.677	.654	+ .023	+ 3.5	18.691	16.166	+ 2.525	+15.6	3.122	2.132	+ .990	+46.4
Total Inland	3.232	3.143	+ .089	+ 2.8	82.904	74.949	+ 7.955	+10.6	10.999	8.060	+ 2.939	+36.5
Total East of Calif.	7.172	6.892	+ .280	+ 4.1	162.267	142.986	+19.281	+13.5	30.363	27.663	+ 2.700	+ 9.8
Calif.	1.223	1.015	+ .208	+20.5	23.529	22.282	+ 1.247	+ 5.6	12.286	12.209	+ .077	+ 0.6
Total U. S.	8.395	7.907	+ .488	+ 6.2	185.796	165.268	+20.528	+12.4	42.649	39.872	+ 2.777	+ 7.0

District	DISTILLATE FUEL OIL STOCKS (Millions of bbl on date shown) Dec. 28 1956	Dec. 30 1955	Change	% Change	KEROSINE STOCKS (Millions of bbl on date shown) Dec. 28 1956	Dec. 30 1955	Change	% Change	TOTAL MIDDLE DISTILLATE STOCKS (Millions of bbl on date shown) Dec. 28 1956	Dec. 30 1955	Change	% Change
East Coast	52.512	41.367	+11.145	+26.9	13.022	11.323	+ 1.699	+15.0	65.534	52.690	+12.844	+24.4
Gulf Coast	17.457	19.488	— 2.031	—10.4	5.368	5.464	— .096	— 1.8	22.825	24.952	— 2.127	— 8.5
Total Coastal	69.969	60.855	+ 9.114	+15.0	18.390	16.787	+ 1.603	+ 9.5	88.359	77.642	+10.717	+13.8
Appalachian	4.367	3.052	+ 1.315	+43.1	1.266	1.044	+ .222	+21.3	5.633	4.096	+ 1.537	+37.5
Ind.-Ill.-Ky.	24.398	19.296	+ 5.102	+26.4	7.514	6.375	+ 1.139	+17.9	31.912	25.671	+ 6.241	+24.3
Okla.-Kans.-Mo.	16.479	11.685	+ 4.794	+41.0	2.193	1.452	+ .741	+51.2	18.672	13.137	+ 5.535	+42.1
Other Inland	6.880	7.020	— .140	— 2.0	2.132	1.394	+ .738	+52.9	9.012	8.414	+ .598	+ 7.1
Total Inland	52.124	41.053	+11.071	+27.0	13.105	10.265	+ 2.840	+27.7	65.229	51.318	+13.911	+27.1
Total East of Calif.	122.093	101.908	+20.185	+19.8	31.495	27.052	+ 4.443	+16.4	153.588	128.960	+24.628	+19.1
Calif.	12.716	10.884	+ 1.832	+16.8	.304	.385	— .081	—21.0	13.020	11.269	+ 1.751	+15.5
Total U. S.	134.809	112.792	+22.017	+19.5	31.799	27.437	+ 4.362	+15.9	166.608	140.229	+26.379	+18.8

Natural Gas and Refinery Gas Liquids





SUPPLY AND DEMAND STATISTICS

(Bureau of Mines Data)

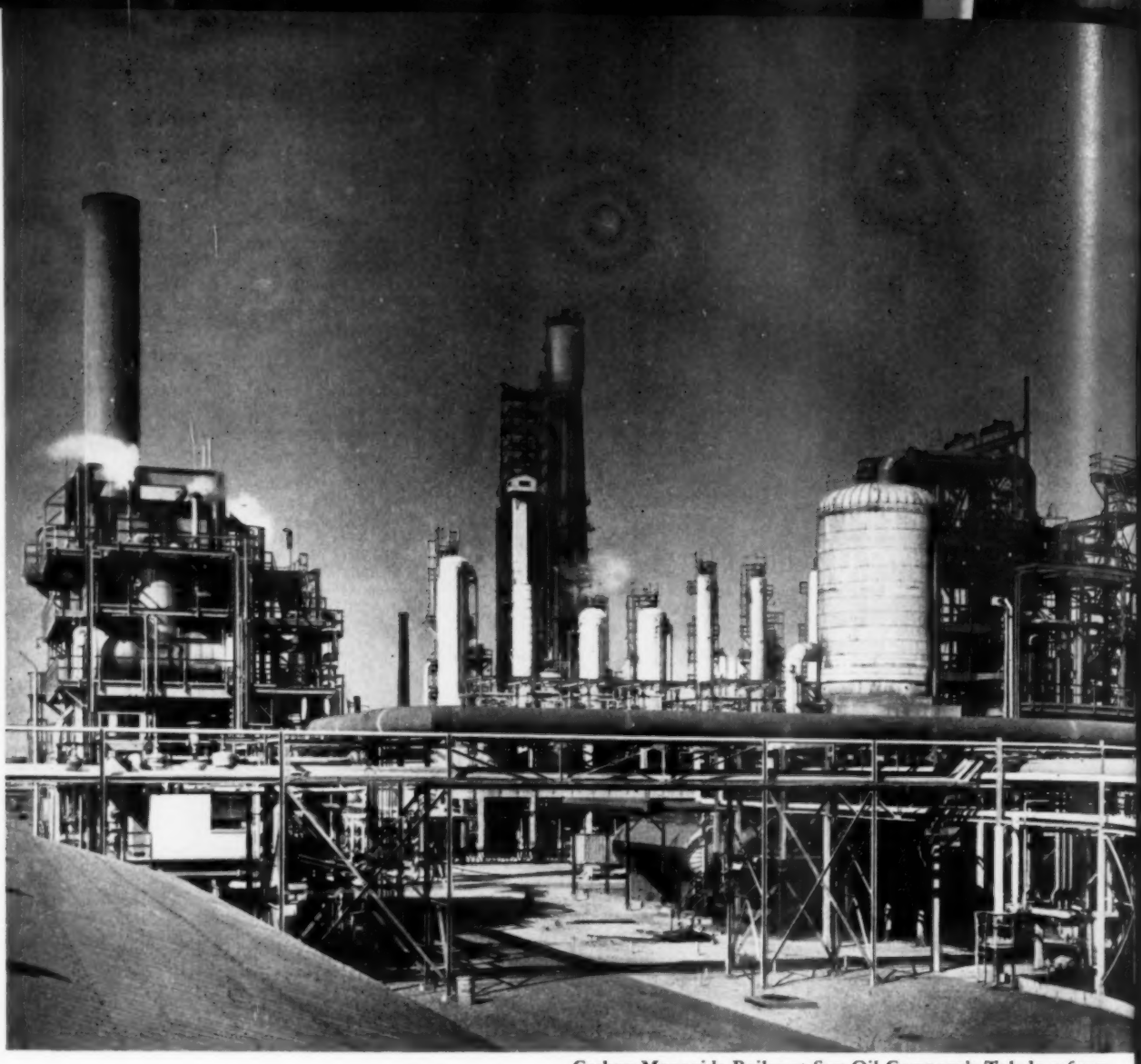
CURRENT PRODUCTION (1000 b/d monthly average)	Oct. 1956	Sept. 1956	Oct. 1955
At Natural Gasoline and Cycling Plants			
Liquefied Petroleum Gas	403	409	381
Natural Gasoline and Isopentane	293	303	283
Condensate	18	7	21
Finished Gasoline, Naphtha and other	68	72	62
Total Natural Gasoline and Cycling Plant Production	782	791	747
Liquefied Refinery Gases	136	143	129
Total Marketable Gas Liquids	918	934	876
Lease Condensate	122	113	114
Total Natural Gas Liquids	1,040	1,047	990

CURRENT DEMAND (1000 b/d monthly average)			
LPG and LRG	515	470	491
Natural Gasoline, Isopentane and other	379	379	365
Total Marketable Gas Liquids	894	849	856

CUMULATIVE PRODUCTION (1000 bbl)	Oct. 1956	Oct. 1955
LPG and LRG	165,488	141,632
Natural Gasoline, Isopentane and other	115,297	109,824
Total Marketable Gas Liquids	280,785	251,456

CUMULATIVE DEMAND (1000 bbl)		
LPG and LRG	158,357	136,846
Natural Gasoline, Isopentane and other	108,047	110,494
Total Marketable Gas Liquids	266,404	247,340

STOCKS (1000 bbl, end of month)	Oct. 1956	Sept. 1956	Oct. 1955
LPG and LRG	17,889	17,130	12,544
Natural Gasoline, Isopentane and other	5,214	5,223	4,456
Total Stocks	23,103	22,353	17,000



Carbon Monoxide Boiler at Sun Oil Company's Toledo refinery.

3 B&W Carbon Monoxide Boilers Save Fuel For Sun Oil

Sun Oil Company has three B&W Carbon Monoxide Boilers in its refineries at Toledo, Ohio, and Marcus Hook, Pa. All are used with Houdriflow cracking units. The first boiler went on stream at Toledo three years ago. The second, at Toledo, and its twin at Marcus Hook, are of the oxycatalyst type.

The three B&W "CO" Boilers are effecting substantial fuel economies at both refineries.

Cracking units at Sun Oil, like others using B&W "CO" Boilers, are completely independent of outside steam and energy sources at all times. Whether or not the cracking unit is operating, steam is always available.

Extended, sustained service has proved the reliability, efficiency, and economy of B&W "CO" Boilers in refineries throughout the nation. They are flexible in design and arrangement to meet varying refinery conditions. B&W engineers can show you how a "CO" Boiler can serve your refinery, regardless of size, steam pressure and temperature requirements. The Babcock & Wilcox Company, Boiler Division, Dept. PP-2, 161 East 42nd Street, New York 17, N. Y.

G-824 CO

BABCOCK & WILCOX

BOILER DIVISION

Inside Story on POWELL PETROLEUM VALVES

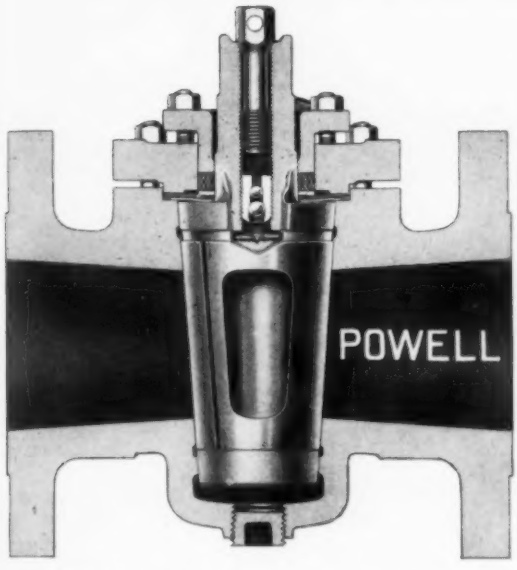


FIG. 2201 (Sectional) -- 200-Pound W.O.G. Semi-Steel Lubricated Plug Valve

Petroleum valves may appear to be alike on the outside. But inside -- in materials, in design, in manufacture -- there can be a world of difference. And the inside story on Powell Petroleum Valves is that every valve has PERFORMANCE VERIFIED.

Only the finest materials are used in Powell Petroleum Valves, and painstaking quality control is rigidly enforced through each step of manufacture

As a final step in manufacture, every Powell Petroleum Valve is subjected to an ACTUAL LINE TEST. Because of Powell's quality control, valve failure is practically unknown. Records from the world over prove it.

Valve users who want one source of supply for Lubricated Plug as well as all types of bronze, iron, steel and corrosion-resistant valves will want full details on Powell Petroleum Valves

Available through distributors in principal cities. If none is located near you -- or if you need help on valve problems -- write direct to The Wm. Powell Company, Cincinnati 22, Ohio.

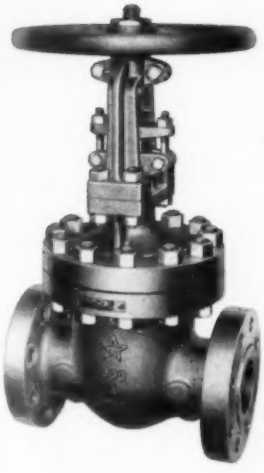


FIG. 9003 -- 900-Pound Steel O.S. and Y. Gate Valve Bolted Flanged Bonnet

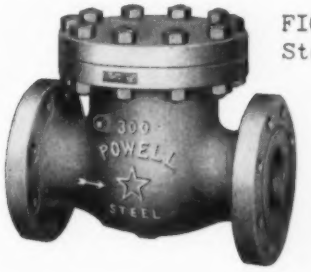


FIG. 3061 -- 300-Pound Steel Swing Check Valve

PERFORMANCE PV VERIFIED

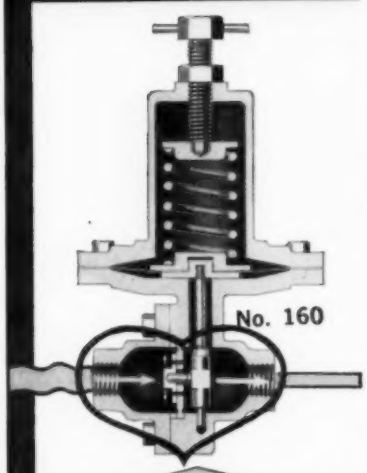
The Wm. Powell Company, Cincinnati 22, Ohio . . . 111th YEAR

POWELL VALVES

BRONZE, IRON, STEEL AND CORROSION RESISTANT VALVES

(To obtain more data on advertised products see page 154)

OPW-JORDAN
pressure reducing
VALVE*



with the Sliding Gate and Plate

the heart of the OPW-JORDAN Valve

THE DIFFERENT AND IMPROVED WAY TO CONTROL PRESSURE.

- DEAD END SHUT-OFF
- WIRE DRAWING MINIMIZED OR ELIMINATED
- SELF-LAPPING SEAT
- NO HUNTING . . . SHORT STROKE FOR IMMEDIATE RESPONSE

The unique Sliding Gate seating design and exclusive features of this valve are responsible for its outstanding performance and long dependable service life. Metallic diaphragm, metal to metal seals, no packing or gaskets to deteriorate, straight-thru body and durable construction assure precise regulation with immediate response and unusual sensitivity under hard, constant use.

*Daily replacing troublesome pilot operated valves.

For interesting facts, write for Bulletin J-160.

JORDAN CORPORATION

INDUSTRIAL SALES DIVISION OF OPW CORP.

6013 Wiehe Road
Cincinnati 13, Ohio
ELmhurst 1-1352

Petroleum Processing

INFORMATION OFFERED

Do you need detailed information on a specific subject? Check through this easy-to-use index of literature and data being offered in this issue's advertisements.

ANTIOXIDANT, for gasoline and other products, information; Koppers Co., Inc. See adv't. p. 32.

BOILERS, steam, bulletin B-55-4; Foster Wheeler Corp. See adv't. p. 17.

CATALYSTS, many types, booklet; Harshaw Chemical Co. See adv't. p. 128.

CLAY, for adsorption, literature; Floridin Co. See adv't. p. 182.

CLEANING COMPOUNDS, for process equipment, booklet; Oakite Products, Inc. See adv't. p. 186.

CONTROL SYSTEMS, automatic, for storage tanks, bulletin CP-3011; Vapor Recovery Systems Co. See adv't. p. 162.

CORROSION INHIBITOR, for scales, technical bulletin; United Chemical Corp. of New Mexico, See adv't. p. 176.

ELECTRICAL EQUIPMENT, for refineries, bulletins GED-1966C, GED-2244; General Electric Co. See adv't. pp. 52-53.

EXPANSION JOINTS, self-equalizing, manual; Zallea Borthers, See adv't. p. 59.

FILTERS, for liquids, literature; Commercial Filters Corp. See adv't. p. 126.

FLOW CONTROLLER, bulletin 470; Foxboro Co. See adv't. p. 146.

GAGE, pressure, data; Jas. P. Marsh Corp. See adv't. p. 178.

GAGE, liquid level, catalog 36; Penberthy Mfg. Co. See adv't. p. 171.

GAS DENSITY BALANCE, data file 22J-27; A. O. Beckman, Inc. See adv't. p. 184.

HEAT TRANSFER EQUIPMENT, bulletin HE-6; Henry Vogt Machine Co. See adv't. p. 27.

INERT GAS GENERATORS, for purging, bulletin 1-10; C. M. Kemp Mfg. Co. See adv't. p. 144.

INSULATION, pipe, new catalog; Union Asbestos & Rubber Co. See adv't. p. 46.

MATERIALS HANDLING, truck, side loading, bulletin 1360; Baker-Raulang Co. See adv't. p. 8.

MIXERS, side and top entering, handbook and bulletins; Eastern Industries, Inc. See adv't. p. 166.

MIXERS, side and top entering, 8 catalogs and data sheets; Mixing Equipment Co., Inc. See adv't. p. 60.

MOISTURE DETERMINATOR, portable, circular 1278; Central Scientific Co. See adv't. p. 20.

MOTOR STARTERS, high voltage, bulletin 8131AM; Electric Controller & Mfg. Co., Div. Square D. Co. See adv't. p. 50.

PACKING, "Teflon," bulletin, Durametallic Corp. See adv't. p. 134.

PROCESS VESSELS, fabrication, booklet; Chicago Steel Tank Co. See adv't. p. 124.

PUMPS, centrifugal, circular 189; Dean Brothers Pumps, Inc. See adv't. p. 19.

PUMPS, high pressure, catalog HP-1254; Philadelphia Pump & Machinery Co. See adv't. p. 164.

PUMPS, stuffingboxless, bulletin 107; Bingham Pump Co. See adv't. p. 161.

REFRACTORY LININGS, catalog; Bigelow-Liptak Corp. See adv't. p. 121.

SEALS, expansion joints and couplings, "Teflon," bulletin EJ-1155; U. S. Gasket Co. See adv't. p. 172.

SEALS, shaft, rubber and plastic, bulletin; Crane Packing Co. See adv't. p. 168.

STEAM TRAPS, impulse type, bulletin; Yarnall-Warning Co. See adv't. p. 35.

STEAM TRAPS, freeze-proof, bulletin 257; V. D. Anderson Co. See adv't. p. 180.

STEAM TRAPS, bulletin 10-55; W. H. Nicholson & Co. See adv't. p. 165.

STEEL, clad and alloy, for process vessels, bulletin; Lukens Steel Co. See adv't. pp. 102-103.

TANK CLEANING EQUIPMENT, bulletin 431; Sellers Injector Corp. See adv't. p. 142.

THERMOCOUPLES, bulletin 325-I; Thermo Eletcric Co. See adv't. p. 142.

TRANSMITTER, for pressure, temperature or flow, bulletin 98226; Taylor Instrument Cos. See adv't. pp. 44-45.

TUBE EXPANDERS, for condensers, catalog 81; Gustav Wiedeke Co. See adv't. p. 170.

TUBE MAINTENANCE TOOLS, cleaners, cutters and expanders, literature; Airetool Mfg. Co. See adv't. p. 160.

TUBES, heat exchanger, steel, booklets; Republic Steel Corp. See adv't. pp. 28-29.

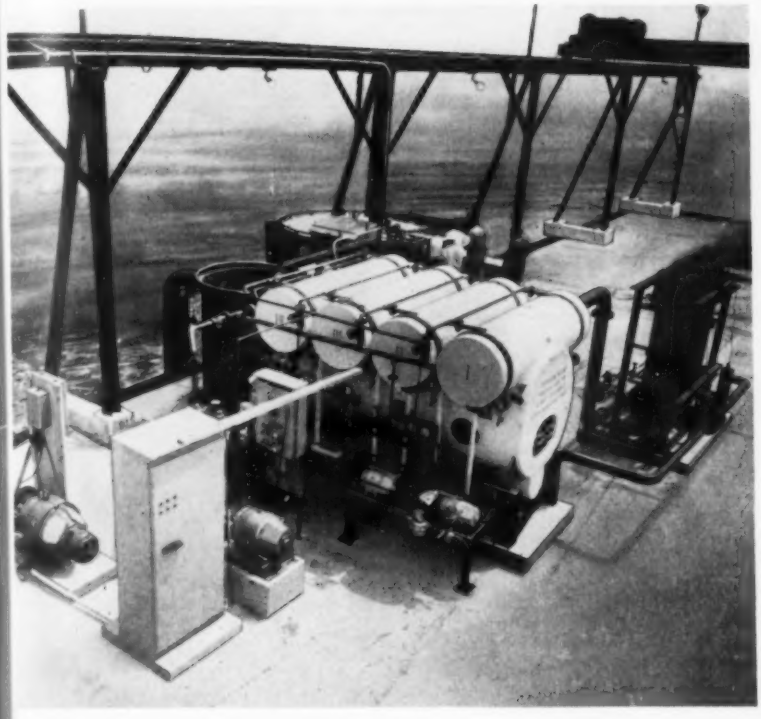
TUBES, reformer furnace, alloys, bulletin T-283; Electro-Alloys Div., American Brake Shoe Co. See adv't. p. 11.

VALVES, control, catalog 70-11; Black, Sivalls & Bryson, Inc. See adv't. p. 54.

VALVES, diaphragm control, bulletin CV53; Kieley & Mueller, Inc. See adv't. p. 104.

VALVE, pressure reducing, sliding gate, bulletin J-160; Jordan Corp. See adv't. p. 152.

VALVES, relief, pop action, bulletin; Crosby Valve & Gage Co. See adv't. p. 116.



Flash Water Still

Produces 1000 Gal Per Hour

Producing distilled water with less than ¼ grain per gal of total solids, this multiple-stage flash distilling unit has just completed more than a month's continuous testing. At the end of the test period the production was well over the capacity of 1000 gal distillate per hour.

This new distilling unit can use low-level heat such as the waste heat from diesel engines or atomic reactors; or it can use inexpensive high-level heat from flare gas. Units are compact and the only moving parts are the pumps. No compression is necessary, contributing to a low noise level. In addition to producing pure water, the unit can be used for decontamination of wastes and the recovery of valuable effluent in streams. **Badger Manufacturing Co.,** Cambridge, Mass.

Circle No. **1** *on Reply Card*

Gas Chromatograph

. . . is a **compact, low-cost instrument** for analyzing gases and low-boiling liquids below 80°C.

The chromatographic columns are copper tubing with standard fittings, which are easily removed. They may be of any length for either absorption or partition analysis. Samples are admitted through a standard serum cap or by a special sampling valve, available as an accessory.

A stream of helium "carrier" gas passing through the column sweeps out at different times the sample components which depend upon their affinity for the absorbing material in the column. The volume of each component gas coming from the column is measured by a diffusion-type thermal conductivity cell that combines fast response with good stability. A one-millivolt potentiometer recorder with 1 second response can be connected to the gas chromatograph for permanent recording of the sample volume. **Scientific Instruments Division, Beckman Instruments, Inc.,** Fullerton, Calif.

Circle No. **2** *on Reply Card*

Mass Spectrometer

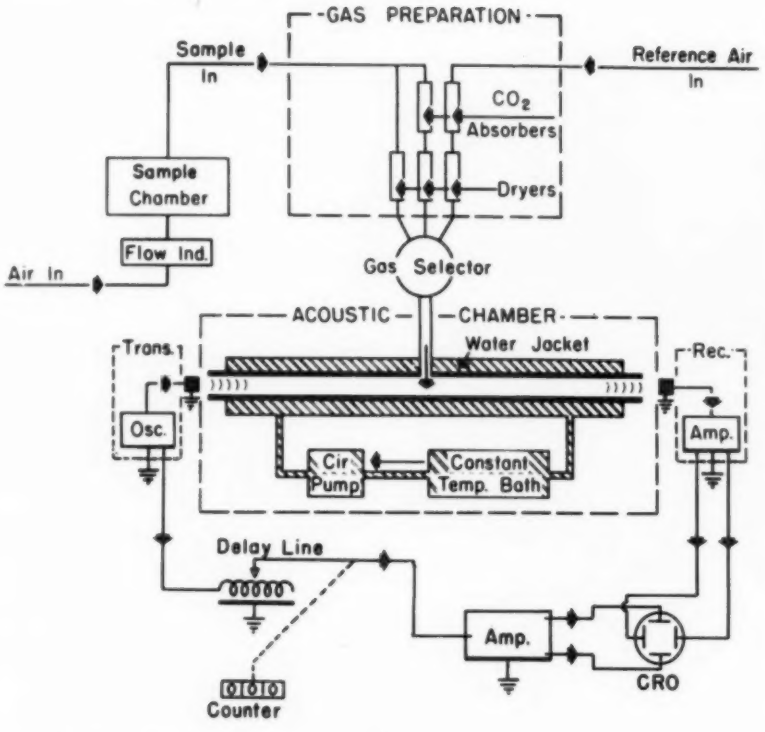
. . . **automatically analyzes** multi-stream and multi-component gases.

A modification of the standard mass spectrometer, this unit was developed to monitor gases from oil wells for close control of underground combustion. It includes nine sample lines—eight for sampling the flowing streams and one for the static standard sample. Each of the eight sample streams flows continuously through a filter to a common exhaust manifold. This continuous flow cuts down the time lag in switching from one stream to another.

An automatic programmer switches each stream and the standard sample in sequence. Time is allowed for flushing and for the peak selector to run through its cycle of selection (up to six peaks) for each stream. Any one of the sample streams can be cut out of the automatic cycle, or any of the streams can be switched manually to the mass spectrometer. **Consolidated Electrodynamics Corp.,** 300 North Sierra Madre Villa, Pasadena, Calif.

Circle No. **3** *on Reply Card*

(Continued on p. 158)



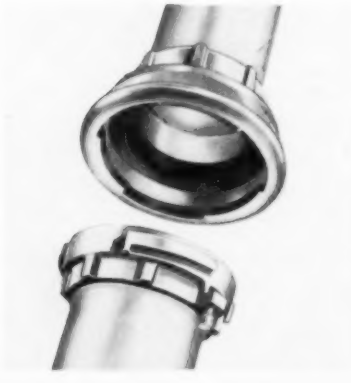
Sonic Gas Analyzer

Accurately Monitors Gas Mixtures

This instrument exploits the wide differences in sonic velocities of gases to achieve measurable sensitivities of 0.005% oxygen in air and 0.00061% of hydrogen. The high accuracy does not mean limited range for the unit retains high sensitivity from 0 to 100 per cent.

The instrument contains a long tube in which the velocity of sound is measured. Gas is fed into the tube at its center and flows out at both ends, so that the velocity of flow is cancelled and does not increase or decrease the rate of sound transmission. Sound waves generated at one end of the sonic tube are received by a crystal transducer at the other. High sensitivity is obtained by using an oscillation frequency of about 150 kc/sec. The phase of the received signal is compared with that of the generating crystal and the phase shift is a precise measure of the change in velocity of sound propagation. **National Instruments Laboratories, Inc.,** 6108 Rhode Island Ave., Riverdale, Md.

Circle No. **4** *on Reply Card*

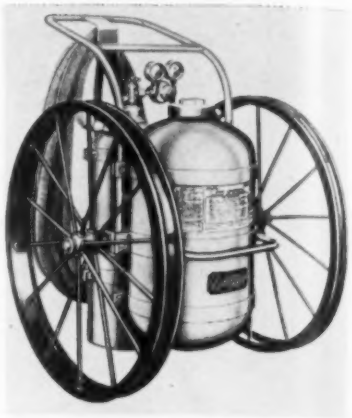


Aluminum Coupler

. . . **for aluminum pipelines** withstands working pressures up to 1,000 psi, and is available in both OD and IPS pipe sizes.

The coupler is secured with just a quarter turn of the heavy breach-acting jaws. A lock screw spins up and locks the coupler against twisting caused by torque of the pipeline. There is no metal part of the coupler exposed to the pipeline fluid because a special aromatic resistant Buna-N gasket seals the joint. The gasket is placed so that there is little disturbance of flow. **John Bean Division,** Food Machinery and Chemical Corp., San Jose, Calif.

Circle No. **5** *on Reply Card*



Dry Chemical Engine

. . . **for Class "B" fires** (oils, paints) uses pressurized nitrogen to expel a smothering dry chemical.

This highly mobile extinguisher unit is available in either a 75- or 150-lb model. The 150-lb model will give approved protection for 80 sq ft of flammable-liquid hazards, such as open tanks or vats. The nozzle is adjustable and permits either a long range stream or a fan stream of the dry powder. **Fyr-Fyter Co.,** Dayton, Ohio.

Circle No. **6** *on Reply Card*

Portable Hand Lamp

. . . **is explosion proof** and designed for tank cleaning or painting. Weigh-

ing less than 11 lb, the fixture uses a 150-watt PAR-38 reflector type spot and flood lamp.

The lamp has a cone-shaped aluminum body that is ridged with heat-dissipating fins. The plastic coated fiber handle, which is located at the balance point for easy carrying, remains cool to the touch. The terminal housing, equipped with a cord clamp with tapered watertight bushing, encloses three connector terminals. **Crouse-Hinds Co.,** Wolf & 7th North Streets, Syracuse, N. Y.

Circle No. **7** *on Reply Card*

Welding Flange

. . . for low pressure service uses a tapered face to concentrate greater force near the bore, thereby giving a better seal.

Rated at 125 lb for water, oil and gas service, the recently introduced flange can be safely bolted to cast iron or semi-steel flanges. Hydrostatic tests indicated that when properly installed, the flange can withstand approximately three times the pressure it could contain if the taper was omitted.

This welding neck flange was designed to meet the requirements of the Code for Pressure Piping which calls for a maximum mismatch of 3/32-in. in low pressure piping. Using this flange will eliminate the need for taper-boring standard 150-lb welding neck flanges or using more costly and high pressure class valves and flanges in order to obtain an adequate seal.

This taper face flange is available in 1- through 12-in. sizes, bored to match 0.188-in. and 0.250-in. wall pipe in sizes 4-in. through 12-in. within the permitted 3/32-in. mismatch. **Tube Turns,** Louisville, Ky.

Circle No. **8** *on Reply Card*

(Continued on p. 160)

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(Use the Reader Service Cards on pages 155-156 to order)

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Evaporation Losses—And their Control in Storage, by Willis A. Bussard; what evaporation is, storage conditions that affect it, equipment and other methods to reduce losses, estimating losses, selecting the right tank. 24 pages, July 1956 . . . . . Reprint **R2** . . . $0.75

Optimum Bubble-Cap Tray Design, by William L. Bolles; presents new concepts and easy-to-use working charts for the process design of bubble-cap trays. 51 pages, 4-part series in February, March, April and May 1956 . . . . . Reprint **R15** . . . $1.50

Chemical Treating of Petroleum Fuels, 4-article symposium on the chemical treatment of petroleum streams from crude through gasolines to convert and/or remove impurities. 24 pages, May 1956 . . . . . Reprint **R12** . . . $0.75

Catalytic Reforming—And Aromatics Recovery in the Refinery, by Virgil B. Guthrie and Robert L. Davidson; what it is and does, who's using or planning to use it, processes for reforming and aromatics recovery. 48 pages, August 1955 . . . . . Reprint **R3** . . . $0.75

Vaporization Equilibrium Constant and Activity Coefficient Charts, by K. A. Smith and R. B. Smith; for use in described conditions ranging up to the critical point of the system. 48 pages, December 1949 . . . . . Reprint **R1** . . . $1.50

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Process Data Sheets are process descriptions with flow diagrams, process conditions, economics, etc. 3-page fold-out sheets—$.20 each, or any 6 PDS or EDS sheets for $1.00:

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PDS 3, **L'Azote Ammonia** **R6**
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PDS 5, **Fluid Coking** **R10**
PDS 6, **Chemico Urea** **R16**
PDS 7, **Ethylene—Stone & Webster** **R18**
PDS 8, **TCP—Socony Mobil** **R21**
PDS 9, **Process References—1947** **R24**
PDS 10, **Ammonia—Kellogg** **R26**
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PDS 12, **Process References—1954** **R32**
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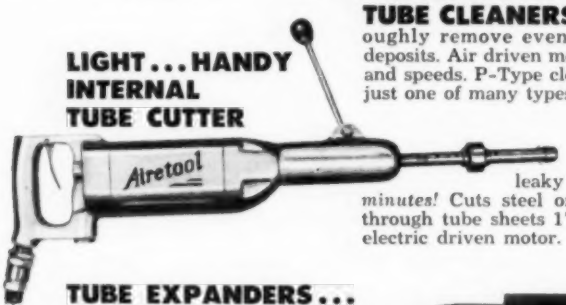
toughest tube maintenance jobs are made easy with AIRETOOL equipment

See for yourself why so many refinery engineers specify AIRETOOL for their tube maintenance programs. AIRETOOL Equipment handles easy . . . is rugged, packs plenty of power and speed, won't bog down or break down during use. AIRETOOL does the *best* job, quickly, economically.

POWERFUL . . . FAST CUTTING TUBE CLEANERS quickly and thoroughly remove even hardest scale and deposits. Air driven motors in various sizes and speeds. P-Type cleaner head shown, is just one of many types available.

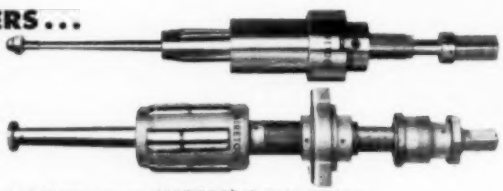
LIGHT . . . HANDY INTERNAL TUBE CUTTER



New . . . removes leaky or damaged tubes in *minutes!* Cuts steel or non-ferrous tubes through tube sheets 1" to 4" thick. Air or electric driven motor.

TUBE EXPANDERS . . .

Parallel rolling . . . self-feeding . . . AIRETOOL Tube Expanders roll tight, accurate tube joints with maximum bond, uniform expansion and tightness throughout full thickness of tube sheet.



Write for illustrated literature on AIRETOOL'S Tube Maintenance Equipment, or see your nearest Airetool Representative.

AIRETOOL
MANUFACTURING COMPANY
SPRINGFIELD, OHIO

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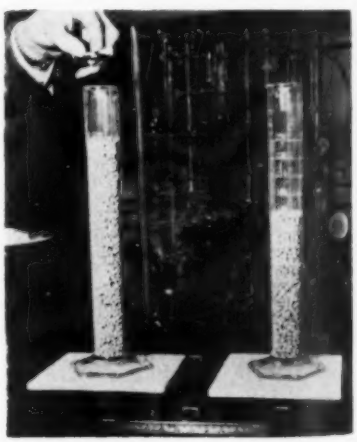
REPRESENTATIVES: in principal cities of U.S.A., Canada, Mexico, South America, England, Europe, Puerto Rico, Italy, Japan, Hawaii.
EUROPEAN PLANT: Vlaardingen, The Netherlands
CANADIAN PLANT: 37 Spaulding Dr., Brantford, Ont.

Speed Transmission

. . . **is adjustable** over a complete range of 8:1, either manually or automatically while the unit is in motion or stopped.

Power is transmitted through a multiple contact of driving and driven discs, floating free on splined shafts. The discs can be replaced easily. The transmission components run in oil, with spur, bevel or worm gear reductions available for installation in any of four planes. Dismantling requires only two sizes of socket wrenches **George E. Clentimack Co., Inc.,** North Attleboro, Mass.

Circle No. **9** *on Reply Card*



Catalyst

. . . **for sulfur removal** has low bulk density, permitting the use of less catalyst while still maintaining a high activity level.

The new product, a cobalt-molybdena catalyst called Aero HDS, reduces the sulfur content of petroleum fractions by conversion to hydrogen sulfide. Plant experience with Aero HDS shows that at 80% removal,

Bingham STUFFINGBOXLESS PUMPS

HANDLE LIGHT HYDROCARBONS* AT HIGH SUCTION PRESSURES

NO STUFFING BOX! NO PACKING!

Bingham Stuffingboxless Pumps are successfully handling liquids having high vapor pressure, requiring high suction pressure and, frequently, abnormally low pumping temperature (—300°).

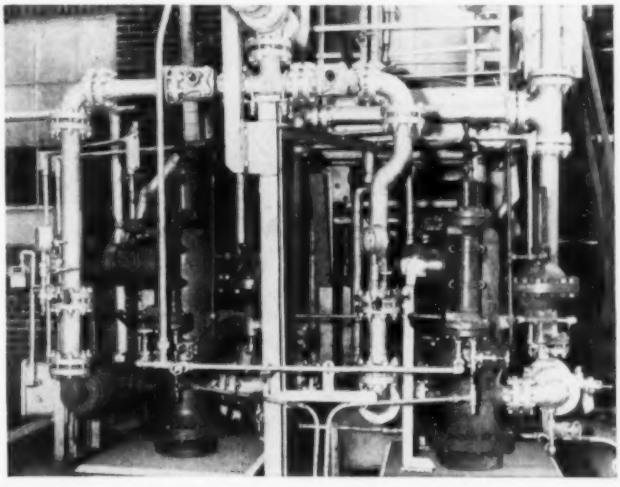
Standard models handle suction pressures up to 2,000 psi (higher pressures available). Pumping temperatures to 850° F. and higher also can be handled.

Bingham Stuffingboxless Pumps are in service today all over the world, with distinguished records in reliability, continuity of service, and low maintenance. Write to your nearest Bingham office for Bulletin 107 or for additional information.

*And other volatile liquids.

BINGHAM STUFFINGBOXLESS PUMPS OFFER:

- Lower overall installed cost
- Less operating attendance
- No misalignment of moving parts
- Smooth operation
- No auxiliary lubricating system
- No exposed moving parts
- Positive motor cooling
- All parts are accessible



Bingham Type KT Stuffingboxless Pumps handling **liquid propane** under high suction pressure at Esso Standard Oil Company refinery, Bayway, New Jersey.

PARTIAL LIST OF MAJOR OIL COMPANIES USING BINGHAM STUFFINGBOXLESS PUMPS

British American Oil Co., Ltd.
Carbide & Carbon Chemical Co.
Canadian Industries
Cities Service Company
Creole Pipe Line Company
Dow Chemical Co.
E. I. duPont de Nemours & Co.
ESSO Standard Oil Co.
Great Lakes Pipe Line Co.
Gulf Oil Corp.
Imperial Oil Company Ltd.
Mitsui Petrochemical Industries, Ltd.
National Petrochemical Co.
Polymer Corporation
Phillips Petroleum Co.
Stanolind Oil & Gas Co.
Sinclair Oil Company
Sohio Petroleum Co.
Standard Oil Company of Indiana
Tennessee Gas & Transmission Co.
Tide Water Associated Oil Co.
Texas Company
Warren Petroleum Co.

Bingham SINCE 1921

DOUBLE VOLUTE PUMPS RADIAL BALANCE

BINGHAM PUMP COMPANY

General Offices: **2800 N. W. Front Avenue, Portland 10, Oregon**

Factories: **Portland, Ore. • Vancouver, B. C., Canada**

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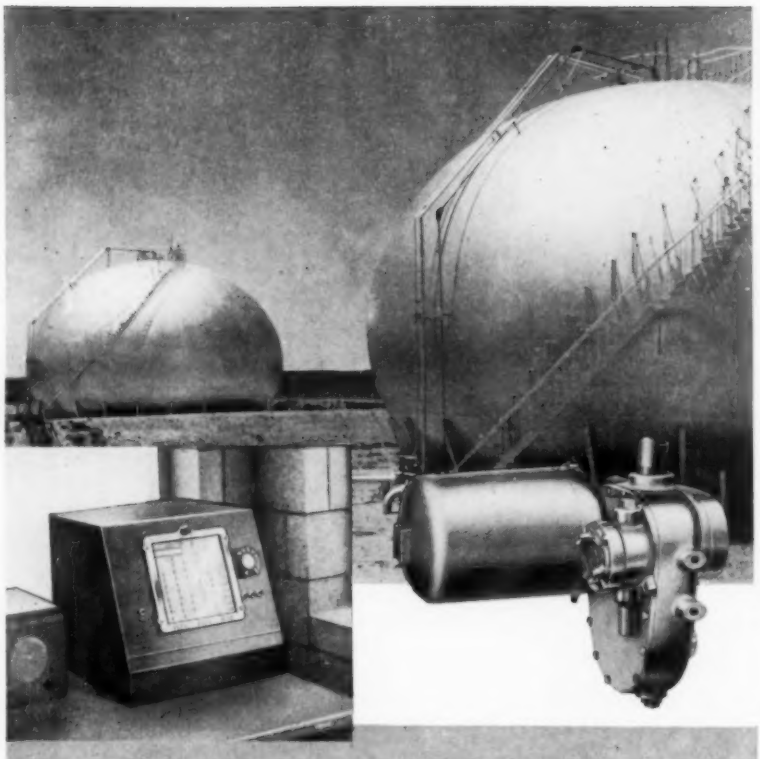
TULSA, OKLA.
TORONTO, ONT., CAN
VANCOUVER, B. C., CAN.

(To obtain more data on advertised products see page 154)

40% more naphtha can be treated over a given weight of catalyst. Or, a given amount of naphtha can be treated with up to 30% less catalyst.

The new catalyst (see p. 135, November issue, PETROLEUM PROCESSING) is designed for service in both new and existing facilities and lends itself to regeneration during use. Preliminary tests indicate that the activity of the catalyst is not adversely affected by regeneration; mechanical properties are influenced some. **American Cyanamid Co.,** Refinery Chemicals Dept., 30 Rockefeller Plaza, New York 20, N. Y.

Circle No. **10** *on Reply Card*



"Varec" PULSE CODE KEEPS "TAB" ON OKAN PIPELINE

Keeping a pipeline flowing smoothly is a mighty big job . . . that's why OKAN PIPELINE wants the latest in automatic equipment to speed its work. An important part of this equipment is the "Varec" PULSE CODE Telemetering System, which signals the liquid level of storage tanks at terminals and along the line. In addition to this function, it turns valves on and off by remote control.

"Varec" PULSE CODE operates over long distances, giving an accurate signal. It requires only a simple metallic pair for a communication link. It supplies a fast reading in the record time of 5 seconds. There is also a unique feature for remote control of valves, pumps, etc., which confirms that the proper selection of remote function has been made and indicates the status of the selected function. The operator may now change the status and receive a confirmation that it has been completed.

You may want to cut your operating costs by using a "Varec" PULSE CODE System. Equipment for reporting either spot or average temperature, in addition to liquid level, is now available.

Write for "Varec" Bulletin CP-3011 for full details on "Varec" PULSE CODE Telemetering.

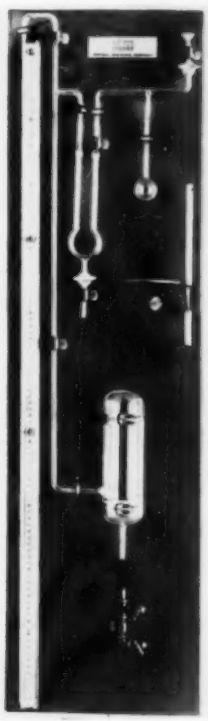
961-17

THE VAPOR RECOVERY SYSTEMS COMPANY

"Varec"

Compton, California, U. S. A.

Cable Address: Varec Compton Calif (U.S.A.) All Codes



Vapor Pressure Apparatus

. . . **increases the accuracy** of low temperature fractional analyses of gases. This instrumenet analyzes the binary mixtures collected between plateaus of any two fractions and provides information regarding the composition of the original mixture.

Developed by Phillips Petroleum Co., the instrument operates by taking the transition fraction obtained from low temperature distillation of the sample and analyzing it further by the vapor pressure method. The transition fraction is transferred to an evacuated bulb in the vapor apparatus at liquid nitrogen temperature. The meas-

"Problem weld between dissimilar alloys ... Inco-Rod "A" takes it in stride!"

says Rolock's Chief Engineer

Rolock Inc., Fairfield, Conn., builds equipment for high-temperature service. To them, difficult welds between dissimilar alloys are an everyday affair.

The weldor above, for example, is completing fabrication of a furnace retort. The flange is steel. The corrugated section at right is Inconel* nickel-chromium alloy . . . to withstand temperatures up to 2050° F.

Trouble at the joint? None at all, now that Rolock is using Inco-Rod "A"* electrode!

"With previous electrodes," writes George Wardwell, Chief Engineer at Rolock, "considerable reworking was needed to eliminate cracks and fissures in problem welds like this one. Now, with Inco-Rod "A" electrode, our weldors work with assurance that the finished weld will be sound in every respect."

Get sound joints when *you* weld dissimilar alloys. With Inco-Rod "A" electrode, you get strong, ductile welds . . . corrosion-resisting . . . of X-ray quality.

And versatile Inco-Rod "A" electrode produces these quality welds in *many* alloy combinations: among ferritic and austenitic stainless steels . . . low alloy and mild steels . . . high-nickel, and other alloys.

What's more, Inco-Rod "A" . . . the electrode with the green flux coating . . . is easy to use. Operates in all positions. Gives spray-type arc and easy slag removal. And manufacturers, who have found that they needed to preheat to prevent hot cracking or fissuring in the weld metal when using other electrodes, find that with Inco-Rod "A" electrode they can produce strong, ductile welds ***without pre-heat.***

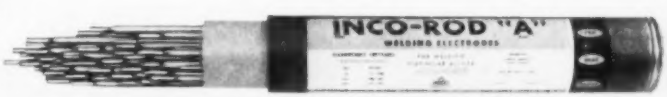
Call on Inco whenever you're faced with a 'problem' weld between dissimilar alloys. If the problem's *now*, write our welding specialists today!

*Registered trademark

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

INCO-ROD "A" electrode is supplied in 14-inch lengths in four diameters: 3/32-, 1/8-, 5/32-, and 3/16-inch (the 3/32-inch is center grip) . . . packed in 5-lb. asphalt-lined containers.

INCO **Welding Products** • electrodes, wires, fluxes



given:

— to add nitric acid to liquid isotope at 4500 psi.

— to pulse liquid extraction columns — 4½ gal. per stroke, 100 strokes per min.

— to pump liquid oxygen at minus 340°F.

— to flow-blend inhibitors in high pressure process lines.

— to charge pressurized-water atomic power systems.

— to pump additions of D_2O to new homogeneous reactors.

PHILADELPHIA SERIES HP HIGH PRESSURE PUMPS

. . . are the solution to these and many other process pumping requirements outside the realm of ordinary proportioning pumps.

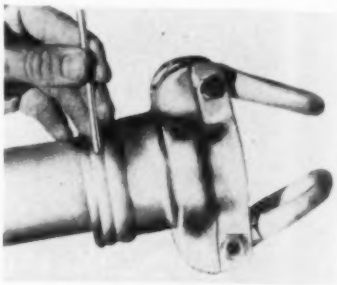
CATALOG HP-1254 describes these *advanced design* Pumps. They meet an entirely new conception of operating requirements—demanded by modern high pressure processing techniques.

PHILADELPHIA PUMP & MACHINERY COMPANY
13500 Philmont Avenue, Philadelphia 16, Pa.
SUBSIDIARY, AMERICAN METER COMPANY

urements of vapor pressure are made under standard conditions at fixed temperatures.

This analysis can be made of binary mixtures ranging from methane to isopentane, nitrogen content of natural gases, and cutpoint between isobutane and normal butane. It can also be used for analyzing samples of natural gas for nitrogen, methane and ethane without previous fractionation. **Central Scientific Co.,** 1700 Irving Park Road, Chicago, Ill.

Circle No. **11** *on Reply Card*

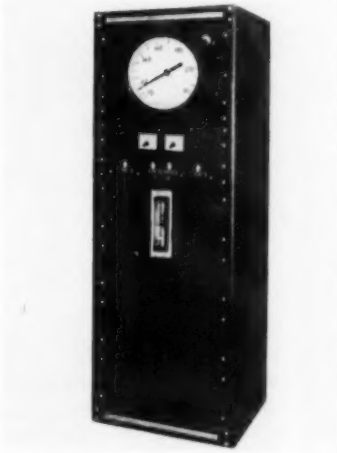


Aluminum Coupling

. . . **can be field attached** without special tools. Designed to join either steel or aluminum IPS pipe, the quick-lock coupling does not need to be welded on at the factory

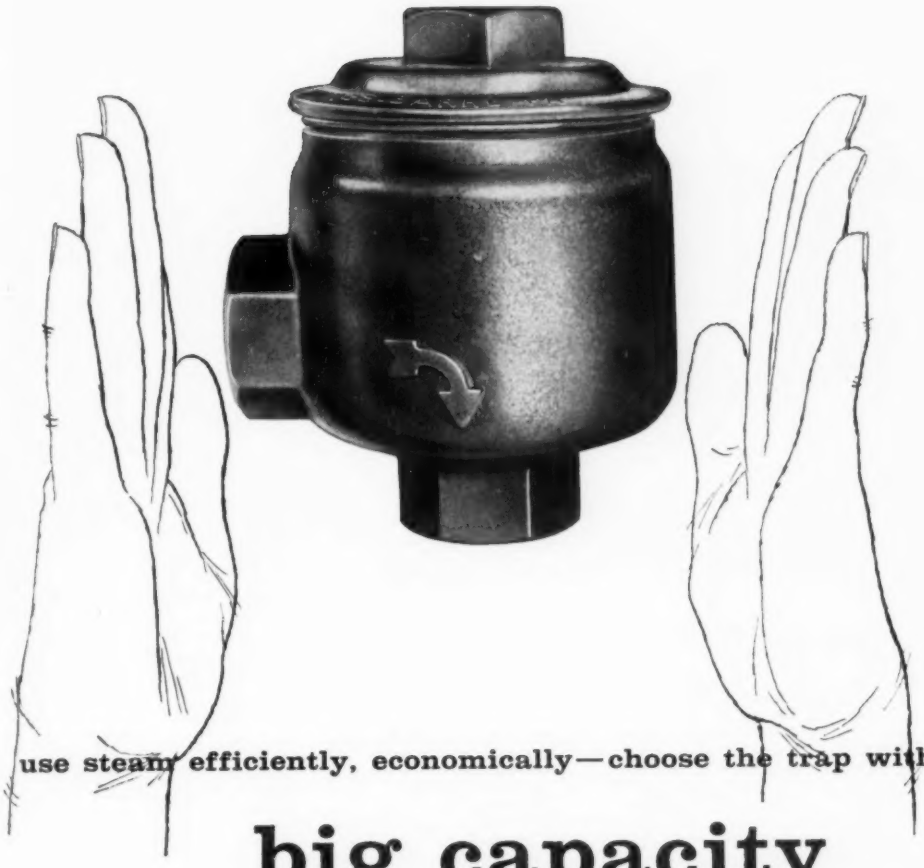
A full line of fittings is available with the new coupling, which is available in 2- and 2½-in. sizes for working pressures up to 500 psi. **Race & Race, Inc.,** Winter Haven, Florida.

Circle No. **12** *on Reply Card*



Automatic Refractometer

. . . **plots refractive index changes** in any non-opaque liquid or gas stream and can continuously monitor and



use steam efficiently, economically—choose the trap with . . .

big capacity

. . . for faster discharge

All a steam trap does is discharge condensate and air from steam lines and equipment—no mystery about it. The bigger its capacity, the faster it can get rid of condensate. But its importance shouldn't be overlooked. On its effectiveness can rest your economical use of steam . . . the efficiency of your process operations.

You get this high capacity in Nicholson steam traps through effective use of a large orifice. And you get much more—simplicity of design and quality through and through.

- **One moving part**
- **Positive shutoff—no steam waste**
- **Powerful, intermittent valve action**
- **Each unit service tested**

Specify Nicholson, and be sure.

Write for new
Bulletin 10-55

NICHOLSON

W. H. NICHOLSON and Company

TRAPS • VALVES • FLOATS • METAL PARTITIONS
LAUNDRY, DRY CLEANING AND PRESSING MACHINERY

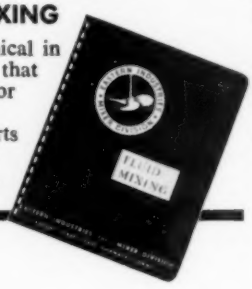
14 OREGON STREET, WILKES-BARRE, PA. • SALES AND ENGINEERING OFFICES IN 98 PRINCIPAL CITIES

(To obtain more data on advertised products see page 154)

97% of MIXING PROBLEMS can be solved QUICKLY!

with 44 pg. HANDBOOK OF FLUID MIXING

Basic guide to the techniques of mixing. Non-technical in expression, it thoroughly explains the many factors that govern the power, size and type of either propeller or turbine mixers and how they apply to process requirements. Also includes easy to use tables, charts and nomographs to help solve every-day problems. *Free on request—ask for Fluid Mixing Handbook.*



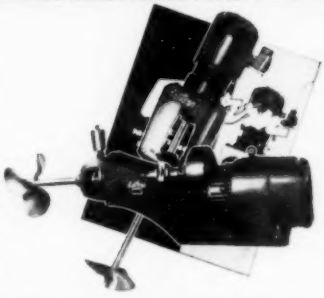
PORTABLE MIXERS

Series H at 1725 R.P.M., Series S at 1125 R.P.M., and Series G at 420 R.P.M. are available in motor ratings from 1/20 to 5 H.P. Also available are special speeds, variable speeds, as well as air driven models. *Request Bulletin 520.*

TOP AND SIDE ENTERING

Series A, extra heavy duty for large tanks, are available in side entering units only within a range of 5-30 H.P. with standard speeds of 280, 420, and 1150 R.P.M.

Series C, for average tank capacities, are available in sizes of ¼ to 10 H.P. at these standard speeds: 1725 R.P.M. (up to 5 H.P.); 1140 R.P.M. (up to 10 H.P.); 420 R.P.M. (up to 7-½ H.P.); 280 R.P.M. (up to 5 H.P.). Available in both horizontal and vertical models. *Request bulletin 620.*



TURBINE MIXERS

Eastern's Top and Bottom Entering Turbine Mixers are particularly applicable where liquid blending requires gentle, yet thorough agitation.

Models are available in sizes from ¼ to 40 H.P. Standard speeds are 56, 68, 84, 100, 125, 155 R.P.M. *Request bulletin 1200.*

Eastern INDUSTRIES, INC.

DEPT. G — MIXER DIVISION Regent St., Norwalk, Conn.

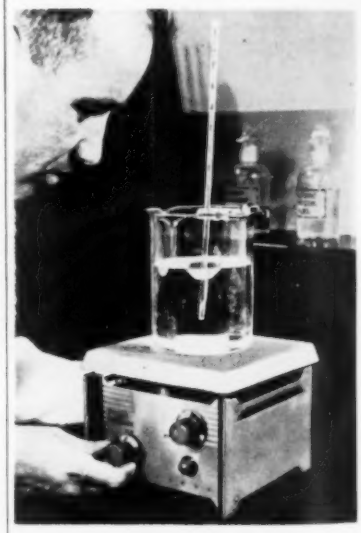
control fractionating towers or stream blending.

Plotting the refractive index (the ability to bend light) of a transparent material is a sensitive means for distinguishing between chemically similar substances. This automatic process refractometer uses this principle to control process streams, both liquid and gaseous.

An optional feature of the instrument is a mass or volume collecting system which measures the amount of solution passing through the test cell. This recorded quantity is plotted on the Y-axis of the X-Y recording chart, and is especially helpful when measuring the eluate in liquid phase chromatography.

This instrument is available for Class 1 Group D requirements, and is designed to operate continuously on 115-volt single phase 60 cycle power. No batteries are required. **Phoenix Instrument Co.,** 3803-05 N. 5th St., Philadelphia 40, Penn.

Circle No. **13** *on Reply Card*



Hot Plate Stirrer

. . . **combines both functions** in one unit, and they can be operated together or separately.

This double-duty piece of lab equipment successfully combines both a heat-resistant stirrer motor and a non-magnetic heating element. The motor is insulated from the hot plate with an effective air-aluminum-asbestos heat barrier. A Fiberglas extension prevents heat from traveling along the motor shaft.

To eliminate magnetic interference and corrosion, the copper-jacketed

PHOENIX QUALITY STANDS OUT ALL OVER

We needn't tell you what kind of life and service you demand from the pipe flanges you buy. The important thing to know is that you are ordering flanges which will be consistently high in quality. Phoenix drop-forged flanges *always* meet the highest quality and strength specifications. No one makes a better flange!

SPECIAL MACHINED FLANGES AVAILABLE
SPECIAL FACINGS • BORES • DRILLING • THREADING

Leading Manufacturers of Pipe and Tank Flanges and Commercial Forgings

PHOENIX

FLANGE AND FORGING DIVISION
PHOENIX MANUFACTURING COMPANY
CATASAUQUA, PA. · JOLIET, ILL. · FOUNDED 1862

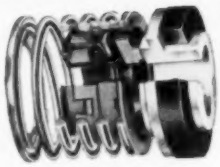
Integrated Manufacturing Facilities: FLANGE AND FORGING DIVISION, STEEL BAR MILL DIVISION, RUBBER PRODUCTS DIVISION AND HORSESHOE PRODUCTS DIVISION

3 JOHN CRANE Shaft SEALS

for lifetime performance in any petroleum or petrochemical service

TYPES 1 and 2

Synthetic Rubber Bellows • For Low Pressure Service



Services: gasoline, diesel fuel, fuel oil, crude oil, butane, propane, ethane and similar products non-injurious to synthetic rubber.

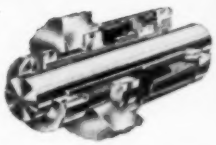
Pressures: to 200 psi.

Temperatures: —40°F to +212°F.

Construction Data: Factory assembled. Self-adjusting sealing head. Lapped faces positively prevent leakage. Low spring pressure for minimum wear. *Available in balanced construction for pressures to 550 psi.*

TYPE 8B

Packaged Type Seal • For High Pressure Service



Services: Same as Types 1 and 2.

Pressures: to 1200 psi.

Temperatures: —40°F to +250°F.

Construction Data: Heavy duty. Hydraulically balanced to handle high pressures. Single-unit package for easy installation.

TYPE 9

Sealing Members Made of Teflon* • Engineered for service conditions that do not permit use of rubber

Services: alkyl benzine, benzine, creosote, silicone oil, some petroleum derivatives, and all known corrosives.

Pressures: to 150 psi. (balanced construction to 750 psi.)

Temperatures: —120°F. to +500°F.

Construction Data: Furnished in the metallurgical specification best suited to the particular service. Flexible wedge ring and sealing ring molded from chemically inert Teflon.

Contact "John Crane" for the shaft seal best suited to your requirements. Request bulletin giving full information on "John Crane's" complete line of mechanical seals.

Crane Packing Co., 6432 Oakton St., Morton Grove, Ill., (Chicago Suburb). *In Canada: Crane Packing Co., Ltd., Hamilton, Ont.*

**DuPont trademark*

JOHN CRANE **CRANE PACKING COMPANY** 38 YEARS INDUSTRIAL PROGRESS

heating elements are cast directly into the aluminum top plate. This arrangement also assures rapid heat transfer from the heaters to the plate. A bimetallic thermostat regulates the top plate temperature for close control. **Fisher Scientific Co.,** 717 Forbes St., Pittsburgh 19, Penn.

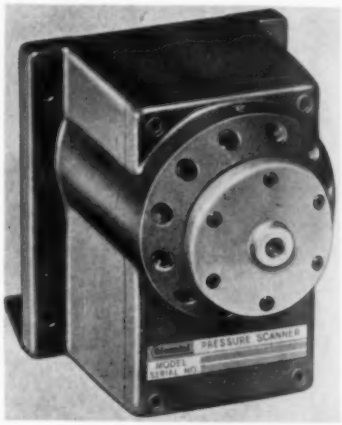
Circle No. **14** *on Reply Card*

Corrosion-Resistant Pump

. . . **uses plastic parts** that are unaffected by sulfuric, hydrochloric and nitric acids.

The full cover around the gear-motor of the pump is of rigid unplasticized polyvinyl chloride. The molded tank, float valve, mechanism and other parts (except the motor, naturally) are also made of the rigid PVC. The pump handles a maximum flow of 25 gph. **The Clarkson Co.,** 564 Market St., San Francisco, Calif.

Circle No. **15** *on Reply Card*



Pressure Scanner

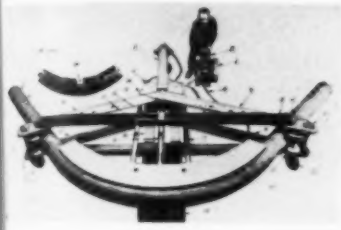
. . . **uses one transducer to** measure 12 pressure sources. Points can be skipped or scanned in any desired sequence by remote control.

Basically, the SP-101 consists of a stator having 12 input ports and a rotor that connects any one of the 12 input ports to an output port. The rotor is rotated to a desired position by a unidirectional high torque motor, whose operation is controlled by means of a positive positioning arrangement. A relay circuit provides dynamic braking to stop the motor in a position where the rotor and stator ports are in coincidence.

The transducer is vented to atmosphere between pressure ports, eliminating transducer hysteresis effects and contributing to greater accuracy. The unit operates over a range from

0.1 psia to 350 psig and is designed with a low internal volume to avoid affecting the pneumatic response of conventional pressure systems. **Datex Division, G. M. Giannini & Co., Inc.,** 1307 South Myrtle Ave., Monrovia, Calif.

Circle No. **16** *on Reply Card*



Portable Pipe Bender

. . . **handles 8-in. pipe** and will bend it up to 90° in a single setting.

Designed for large-pipe field bending, this unit has a frame that can be folded together onto the top of the hydraulic ram for easy transportation. It is easily operated and will handle a 90° bend on an 8-in. pipe in 3 minutes, using a 2 hp motor pump. It can also use a ½-hp motor or a gasoline motor.

The same type of bender is available to handle 2-, 3-, 4- and 5-in. pipe. An attachment for making 180° bends in one shot is available for all pipe sizes. This bender can also be obtained with a built-in integral frame and hoist for handling materials in the field. **Tal Bender, Inc.,** Milwaukee 2, Wis.

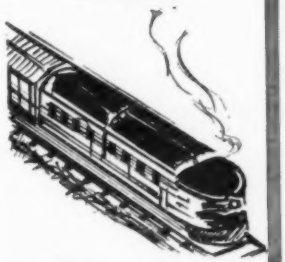
Circle No. **17** *on Reply Card*

Locking Device

. . . **creates a safe unloading bridge** between railroad car and a dock or truck. It can be positioned and repositioned without tools.

An easy pull on a lever arm opens the jaws of the Span-Lock and permits its repositioning at the edge of the loading dock. A firm push against the lever arm locks the jaws to the side

reodorize petroleum malodors with Alamask!



Make olfactorily acceptable petroleum products!

Producers of petroleum products and of petro-chemicals – by adding a selected ALAMASK reodorant – can improve odor characteristics of such materials. A specific ALAMASK is available to achieve adequate reodorization of a variety of petroleum products.

FOR REODORIZATION OF:

FUEL OILS *(regular or premium gasoline blends)*
KEROSENE
DIESEL OILS
CUTTING OILS and SPECIALTIES
many other petroleum products

Gain olfactory relief with an ALAMASK.

Write, wire or phone for specific information. Our Engineering Section provides complete technical guidance.

Rhodia INC.

60 East 56th Street, New York 22, N. Y.
Philadelphia • Cincinnati • Chicago • Los Angeles
Canada: Naugatuck, Montreal • Cuba: Luis Felipe, Havana • Mexico: Commerciale Reka, Mexico City

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You can use the Reader's Service Card in this issue of PETROLEUM PROCESSING to order reprints. Here's how:

- Check the list of reprints on page 156.
- Circle the proper "R" letter on the Reader's Service Card (Area "C").
- Fill in your name and address—and send the card to us.

We'll bill you with the reprints

(To obtain more data on advertised products see page 154)

WIEDEKE

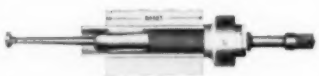
THE QUALITY NAME IN TUBE EXPANDERS . . . SINCE 1892

Tube Expanders for Condensers

No. 255—for average tube sheets

No. 270—for thick or multiple tube sheets

No. 255—Adjustable for sheets up to 2¼" thick



No. 270—Adjustable for sheets up to 7½"

#36

IDEAL

IDEAL Ball Bearing Tube Expanders are made of special analysis alloy tool steels, carefully heat-treated to withstand the severest operating strains. They are adaptable for use with any torque controlled tube rolling units—air, electric or mechanical. *Confidence* is your assurance that your job will be done *RIGHT* . . . when you use WIEDEKE Specialized Tube Expanders, Tube Cutters and Operating Accessories. There is a Wiedeke Distributor in every principal city. For further information write for *new* General Catalog 81.

The Gustav WIEDEKE Company
Dayton 1, Ohio

NEED ENGINEERS?

An employment advertisement in our CLASSIFIED advertising section will help you find the engineers you need. It's an inexpensive, time-saving method of contacting competent personnel for every engineering job in refining and petrochemical industries. The select circulation of PETROLEUM PROCESSING offers you an opportunity to choose the best qualified men available. For rates and information write:

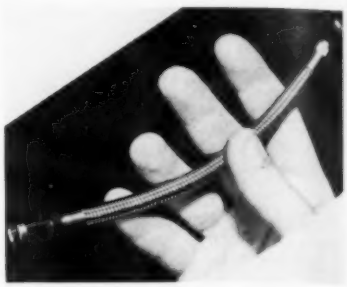
Classified Advertising Division

PETROLEUM PROCESSING

330 West 42nd Street **New York 36, New York**

of the "Dockboard" safety curb, made by the same manufacturer. The bottom of the Span-Lock extends down into the span between dock and carrier, fitting flush against the edge of the dock. **Magnesium Company of America,** Materials Handling Division, East Chicago 19, Ind.

Circle No. **18** *on Reply Card*



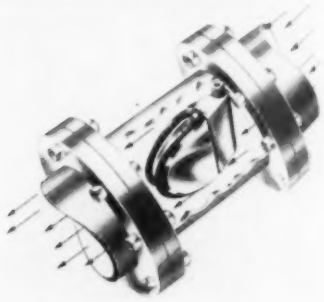
Flexible Hose

. . . **uses Teflon liner** for chemical resistance, encased in a stainless steel wire braid. Full flow fittings are permanently locked to the hose.

The hose assemblies will withstand operating pressures up to 400 psi at temperatures from —100 to +500°F. They are recommended for use where maximum chemical resistance and wide temperature and pressure conditions are apt to be encountered.

Eight sizes are available from stock, ranging from 3/16 to 1⅛ in. with a maximum length of 50 ft. **The Mic-Lin Co.,** Route 38 at Rudderow Ave., Maple Shade, N. J.

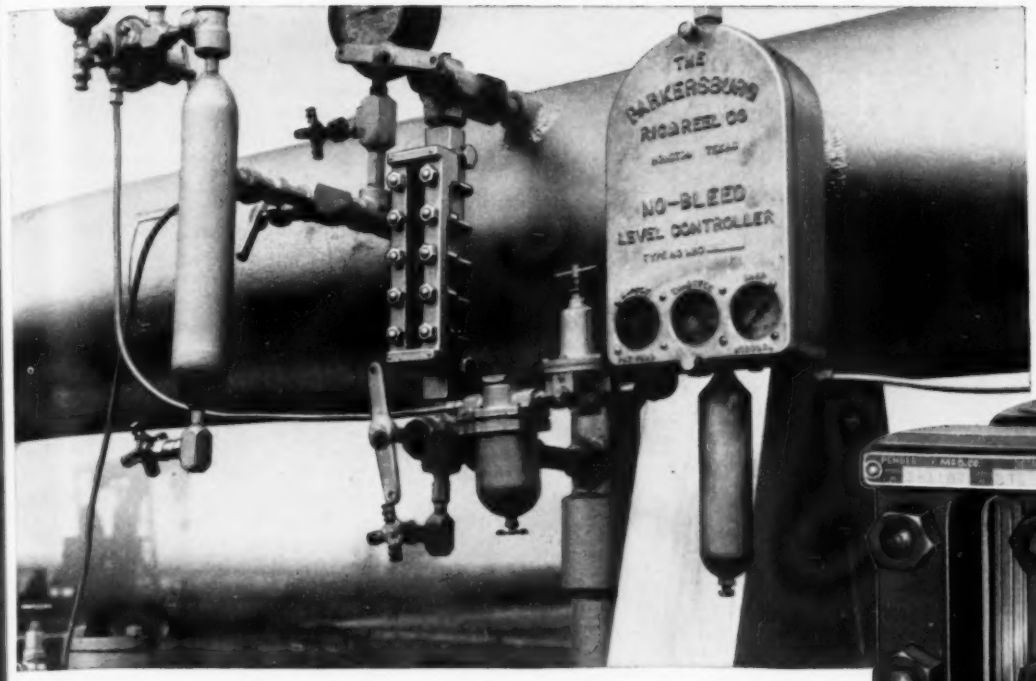
Circle No. **19** *on Reply Card*

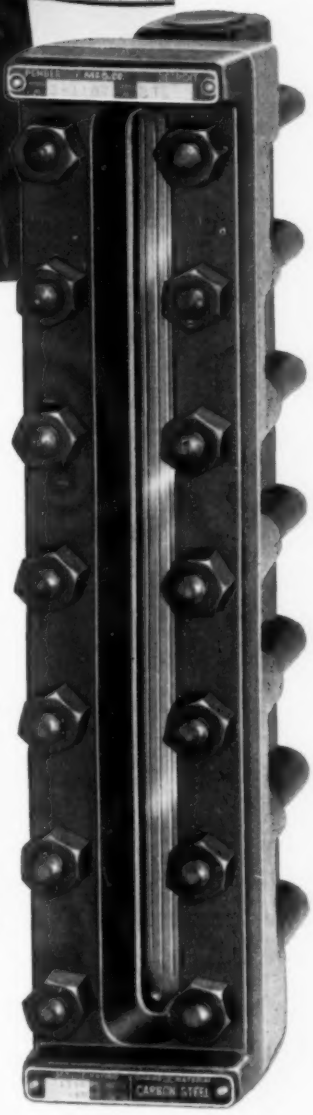


Plastic Check Valve

. . . **handles corrosive gases,** vapors and fluids in any flow system using polyvinyl chloride. It can be installed in any position.

Called "Technocheck-PVC," the valve uses the same principle of the company's metal check valves. Bodies are fabricated of tubing, and the





"PENBERTHY GAGES
are PREFERRED by
OUR CUSTOMERS"

say Parkersburg Engineers. "PENBERTHY gages are preferred as accessories by the men who specify and use our pressure vessels. They are established as a quality product in the minds of most of our customers. That's good enough for us!"

This PARKERSBURG single-stage horizontal separator is used to separate oil well fluids into liquids and gas. It is only one in the famous line of PARKERSBURG separators equipped with PENBERTHY gages.

To closely regulate interface surfaces, a special NO-BLEED level controller (above) assures quick dump valve opening and controls the amount of oil discharged.

For DOUBLE PROTECTION, a PENBERTHY liquid-level gage provides instant visual proof that interface levels are properly maintained.

Similar applications are found throughout the refinery and petro-chemical industries where accurate liquid-level readings are vitally important.

To provide the kind of service these industries require, PENBERTHY gages are designed and tested for rugged strength and accurate performance. The exclusive "raised face" glass reduces internal stresses assuring longer glass-life and a minimum of maintenance.

PENBERTHY gages may be purchased through supply stores in your area. For detailed information on complete PENBERTHY line, write for free copy of Catalog #36.

PENBERTHY MANUFACTURING CO.

Division of Buffalo-Eclipse Corporation

1242 Holden Avenue **Detroit 2, Michigan**

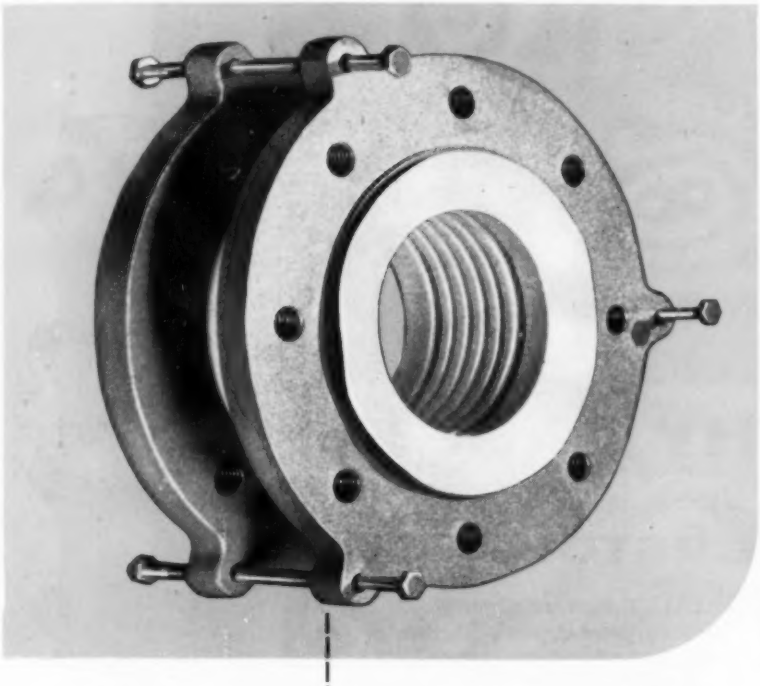
***There's Certain Satisfaction in* PRODUCTS BY**

PENBERTHY

- EJECTORS
- INJECTORS
- CYCLING JET PUMPS
- ELECTRIC SUMP PUMPS
- LIQUID LEVEL GAGES
- GAGE VALVES

(To obtain more data on advertised products see page 154)

they supply the "GIVE and TAKE" for safe piping seals



made of du Pont TEFLON

Chemiseal Expansion Joints and Flexible Couplings—Made of TEFLON—protect costly chemical piping, usually low in impact strength.

They absorb shock, vibration, thermal expansion and contraction. Correct misalignment. Connect unlike piping ends and nozzles. Eliminate gaskets, adaptors and slip joints. Are impervious to *all* chemicals excepting only molten alkali metals, fluorine under pressure and chlorine trifluoride.

All TEFLON Expansion Joints and Flexible Couplings are pressure tested at the plant . . . and flexural tested, too, for special requirements.

Write for Bulletin EJ-1155.

UNITED STATES GASKET CO.

CAMDEN 1, NEW JERSEY

flanges meet ASA Standards. Internals are of PVC with sealing members of plasticized PVC, neoprene, or Buna N—all reinforced with nylon for high strength. Metal parts are of stainless steel.

The unit is available in standard sizes from 1 to 8 in., with male threaded ends from 1 to 4 in., or with standard flange or socket ends. **Techno Corporation,** 16 West 5th Street, Erie, Pa.

Circle No. **20** *on Reply Card*

Free Trade Literature

Petroleum Processing Index

. . . for 1956: includes subject and author indexes for all feature articles and regular departments published during the past year. Available now from McGraw-Hill Petroleum Publications, 330 West 42nd St., New York 36, N. Y.

Circle No. **100** *on Reply Card*

High Pressure Pumps

. . . for pressures up to 35,000 psi and capacities to 2,000 gph: *Catalog HP-1254* describes the different kinds of pumps which are available for high pressure applications outside the realm of ordinary chemical proportioning pumps. Offered are 298 models of these pumps in 3 basic pump frame sizes for 2-, 3-, and 4-in. pump strokes. Philadelphia Pump & Machinery Co., 13500 Philmont Ave., Philadelphia, Penn.

Circle No. **21** *on Reply Card*

Technical Manual

. . . on a versatile chemical intermediate: *Ethylene Oxide* is a 43-page technical bulletin presenting available information on analytical procedures, physical and chemical properties as well as industrial uses of this material. Data is also included on handling techniques, toxicity, and specifications on the various grades offered by Jefferson Chemical. A documented bibliography lists almost 500 literature references on this petroleum-derived chemical. Jefferson Chemical Co., Inc., P. O. Box 303, Houston 1, Texas.

Circle No. **22** *on Reply Card*

Wood Chemicals

. . . that may find uses within the refinery industry: Orzan A and Orzan S are described in *Bulletin CZ 658*. Some of the present uses for these

Sinclair-BAKER

RD 150

..MOST EFFICIENT PLATINUM CATALYST FOR HIGH OCTANE OPERATIONS..."

BAKER'S RD 150 has proved to be the most efficient of all platinum catalysts, *especially* so for high octane operations. It assures important yield increases at high octane levels . . . exceptionally long periods of operation . . . and *regeneration in situ!* The total result is a unique combination of telling advantages that facilitate production quality, quantity and operating efficiency at the lowest cost level.

RD 150 is a joint development of Baker & Company, Inc. and Sinclair Research Laboratories. It is now being used in successful production by such companies as Sinclair, Socony and Pure Oil.

The very extensive facilities for manufacture and refining in modern Baker plants provide full assurance of prompt deliveries and service. The complete RD 150 story will be interesting to you.

A Baker representative will be glad to give you detailed information upon request.

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THE HUB OF PLATINUM METALS RESEARCH

NO.2 in a series of ALUMICOAT APPLICATIONS

RESISTS HIGH TEMPERATURE CORROSION!

Alumicoat

Molten Aluminum

PROCESS PROTECTS REFINERY EQUIPMENT

More and more refineries are discovering the advantages of the new ALUMICOAT Process! ALUMICOAT offers a firm resistance against corrosive media — *especially sulphur compounds* — and extreme temperatures!

In the ALUMICOAT Process, refinery parts are dipped in molten aluminum to produce a metallurgical iron-aluminum bond at the interface and a surface overlay of pure aluminum. At temperatures exceeding the melting point of aluminum, the aluminum on the surface diffuses. This diffused coating, together with the iron-aluminum bond, provides a refractory material that gives steel maximum protection against high temperature scaling.

The Alumicoat Process can solve your corrosion and oxidation problems. Send for full details today!

ARTHUR TICKLE ENGINEERING WORKS, INC.

24 Delevan Street MAin 5-4200 Brooklyn, N. Y.

lignin chemicals (derived from wood pulping) are as stabilizers in asphalt emulsions, as binders in furnace linings, and as scale inhibitors for boiler water treatment. Other potential uses are sketched in this 24-page booklet. Crown Zellerbach Corporation, Chemical Products Div., Camas, Wash.

Circle No. **23** *on Reply Card*

Infrared Analyzer

. . . for continuous measurement of a single gas or liquid component: *The Bichromator Analyzer* is a new dispersive infrared plant instrument designed for use directly on process streams. It will monitor the concentration continuously of any selected component in the stream. This bulletin describes the principle of operation, special features, and operating characteristics of the instrument. Perkin-Elmer Corp., Norwalk, Conn.

Circle No. **24** *on Reply Card*

Plastic Pipe Catalog

. . . lists three materials: PVC (polyvinyl chloride), styrene copolymer, and Buna N (acrylonitrile-butadiene). *Catalog P101* includes technical and descriptive data about plastic pipe, fittings and valves made from these three materials. Tables detail the physical and chemical properties of each. Also included are lists of sizes, working pressures and dimensions of all the products made. Vanton Pump & Equipment Corp.

Circle No. **25** *on Reply Card*

Research Reactors

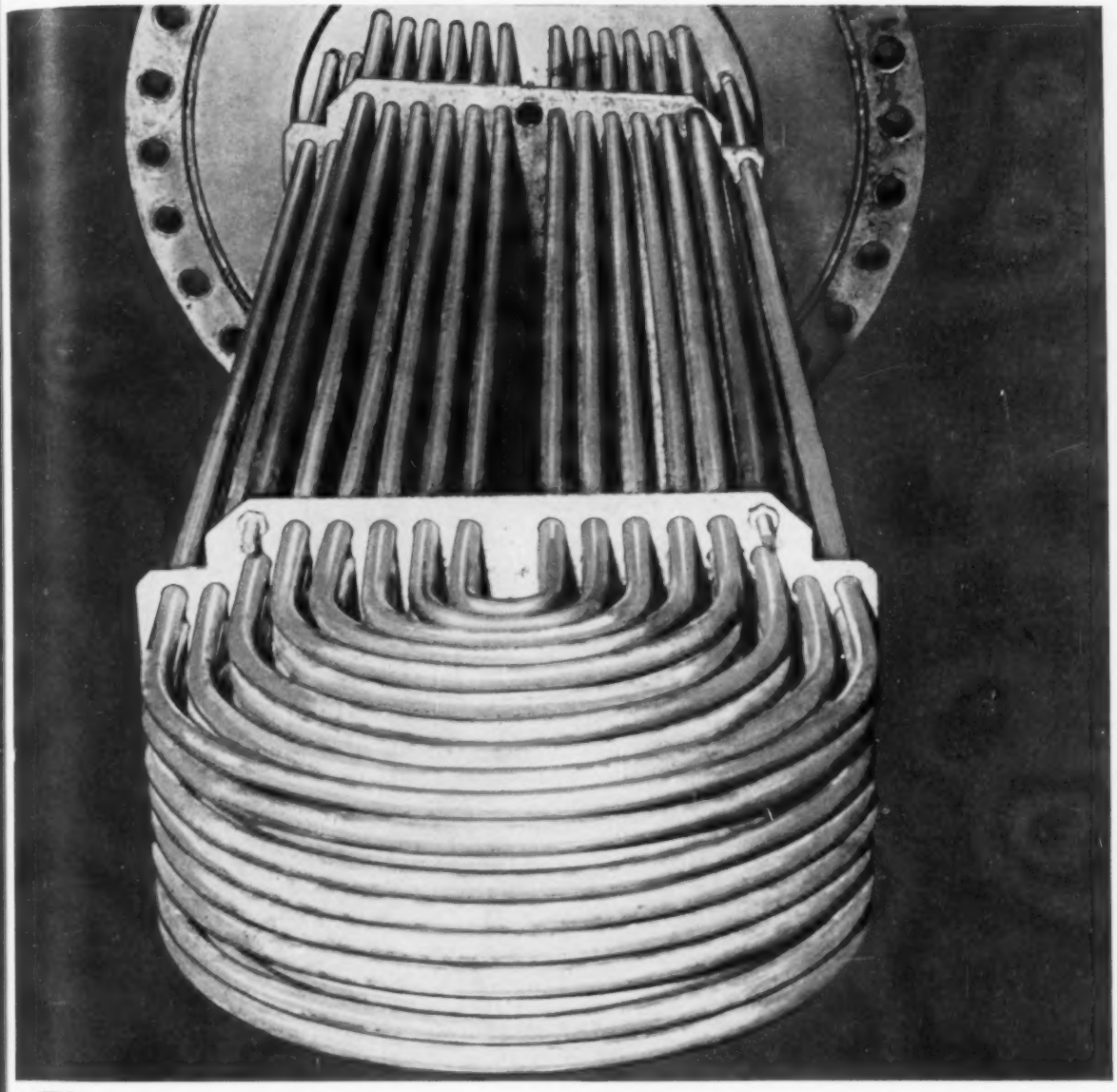
. . . three types now for sale: *Bulletin GEA 6326-B* describes in some detail the three types of nuclear test reactors which are now available. Described in words and pictures are the swimming pool reactor, the heavy water, and the nuclear reactor. Specific uses, design characteristics, safety features, experimental features of all types are covered. Also included is a quick-comparison table for the three reactors. General Electric Apparatus Sales Division, Schenectady 5, N. Y.

Circle No. **26** *on Reply Card*

Electron Microscopes

. . . their construction and operation: *Booklet RC-178* gives complete data on this research instrument. Included are descriptions of the electron optical system, pumping unit, lenses, cameras and other elements of these instruments that have the power of magnifying objects 100,000 diameters. North

(To obtain more data on advertised products see page 154)



Carpenter Stainless No. 20Cb Tubing withstands Tortuous Fabrication and Service

Note the tortuous hairpin bends in this tube bundle used in a large oil refinery to handle concentrated H_2SO_4 at temperatures from 175-194°F, and pressures from 300-400 psi. Whenever and wherever *you* design or use equipment that handles severe corrodents, check the service-proved cost-saving results you can expect with Carpenter Stainless No. 20 and No. 20Cb. Ask your Carpenter Distributor about these super stainless alloys available in tubing, pipe, sheet, plate, bars, wire, strip and billets.

MEMBER

The Carpenter Steel Company, Alloy Tube Division, Union, N. J.

Export Dept.: The Carpenter Steel Co., Port Washington, N.Y.—"CARSTEELCO"

Carpenter

more than corrosion resistance

Stainless Tubing & Pipe

Carpenter No. 20 bars, strip, wire and billets are available also from The Carpenter Steel Company, Reading, Pa.

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Gas and Vapor Phase Chromatography At Its Best!

Burrell Kromo-Togs are complete and versatile instruments for the quick and accurate analysis by elution of most gases and volatilized liquids.

Model K-2 (pictured) accommodates two separate columns for maximum flexibility and operating economy in plant or laboratory.

Features include the finest detector cell available, variable column temperature control and other exclusive developments of Burrell laboratories. ⊙ Trademark

SPEEDY
Cuts analysis time to minutes even for complex compounds.

FLEXIBLE
Designed for ease of operation in research or process control.

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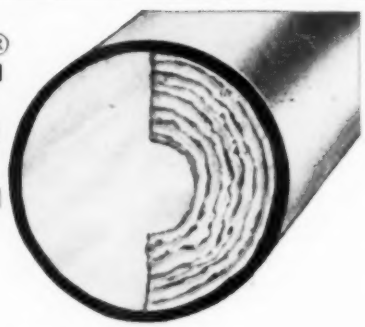
Scientific Instruments and Laboratory Supplies
2223 Fifth Avenue, Pittsburgh 19, Pennsylvania

how * ® **KE-TONE** **prevents and removes scale**



KE-TONE utilizes the best features of the polymerized phosphates and the amino acid chelates to inhibit scale formation and actually dissolve and remove scale deposits. The **KE-TONE** method of treating the large volumes of water used in cooling towers, boilers and other industrial installations, ***loosens, fractures, suspends*** and in many instances actually ***dissolves*** scale. Any suspended or dissolved scale may then be removed in the effluent from the system or in the blow-down. So effective are small concentrations of **KE-TONE** that large volumes of water may be treated with utmost economy.

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KE-TONE — "Makes Water Work"

UNITED CHEMICAL CORPORATION
OF NEW MEXICO, HOBBS, NEW MEXICO

What's New

American Philips Co., Inc., 750 S. Fulton Ave., Mount Vernon, N. Y.
Circle No. **27** *on Reply Card*

Analyzer Unit

. . . for gas analysis: *Bulletin 56-1008-59* explains the principle, construction and operational features of the Hays Condu-Therm Analyzer used for determining amounts of CO_2, H_2, CH_4 and other gases. A typical installation for flue gas analysis is described and diagrammed. The Hays Corporation, Michigan City, Ind.
Circle No. **28** *on Reply Card*

Petroleum Dyes

. . . and how they are used: *Booklet A-2723* describes the chemical and physical properties of these petroleum colorants, their solubilities, government specifications, tests, and many other facts for the petroleum processor who is using dyes. Included in the publication are diagrams of dye addition systems plus operational hints. E. I. du Pont de Nemours & Co., Petroleum Chemicals Div., Wilmington 98, Calif.
Circle No. **29** *on Reply Card*

Zeolite Softeners

. . . for treatment of water: *Publication 4520* is a 20-page booklet explaining the fundamentals of zeolite water softening and how to select the proper equipment and zeolites. The same bulletin also describes the operation of the Cochrane Hydromatic valve for control of the cycling process. Cochrane Corporation, 17th below Allegheny, Philadelphia 32, Penn.
Circle No. **30** *on Reply Card*

Jacketed Pipe, Fittings

. . . for maintaining uniform temperatures, either hot or cold: *Bulletin J-57* describes jacketed systems designed to handle, in a free-flowing state, hot processed materials that are ordinarily sticky, solid or semi solid at atmospheric temperatures. Included in this booklet are descriptions of jacketed strainers, valves, pipe, flexible hose and special fittings. Hetherington & Berner Inc., 701-745 Kentucky Ave., Indianapolis 7, Ind.
Circle No. **31** *on Reply Card*

Cost Estimation Data

. . . for impervious graphite processing equipment: *Bulletin No. 249* is a 29-page report designed to help with the cost estimation and selection of this

choose from 3 approaches to higher octanes with ISO-PLUS HOUDRIFORMING

The new HOUDRY ISO-PLUS Process combines the proved advantages of catalytic HOUDRIFORMING with other processes to economically reform low-octane naphthas into gasolines with octane ratings in excess of 100-octane F-1 clear. This catalytic reforming process offers refiners practical approaches to higher octanes at relatively low investment.

High-Octane Alternatives with ISO-PLUS HOUDRIFORMING

ISO-PLUS Aromatics Extraction Combinations

1. Iso-Plus Houdriforming with separate Houdriforming of paraffinic raffinate

2. Iso-Plus Houdriforming with recycling of paraffinic raffinate

Variations of the Iso-Plus Process employing aromatics extraction have produced yields of 100-octane gasoline, F-1 clear, of up to 91% of naphtha charge. Slight changes in operation permit refiners to further increase gasoline product octane.

ISO-PLUS Thermal Processing

3. Iso-Plus Houdriforming with thermal reforming of Houdriformate

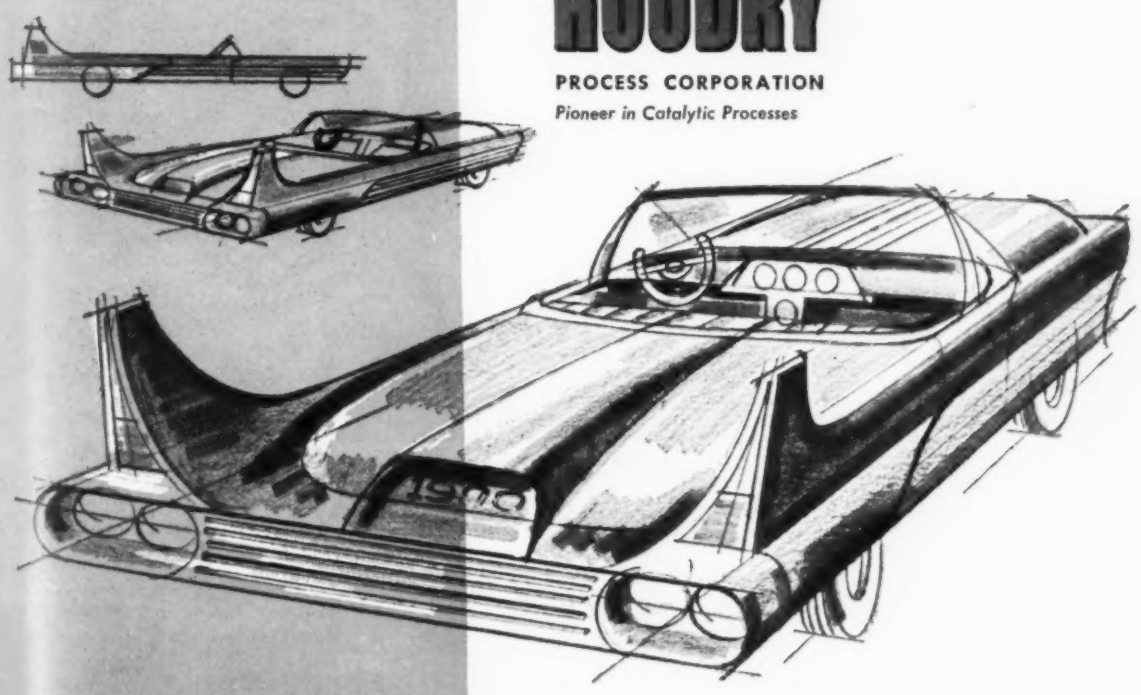
With thermal reforming as the supplementary process, Iso-Plus processing yields 80% to 90% of reformed gasoline, depending upon the desired octane rating of the final product. This operating scheme is especially attractive to refiners with available thermal reforming equipment.

For further information, write to Houdry Process Corporation, 1528 Walnut Street, Philadelphia 2, Pa.

HOUDRY

PROCESS CORPORATION

Pioneer in Catalytic Processes



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A SUPERIOR SWEETENING REAGENT IN PETROLEUM REFINING

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We are in a position to supply your needs on annual, semi-annual or monthly contract basis—also smaller quantities in drop shipment lots.

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Lower Moisture
Uniform Particle Size
Uniformity
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For
1. Quality Improvement
2. Cost Reduction

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Copper	37.00% minimum
Moisture	12.00% maximum
Fe	.04% maximum
Zn	.01% maximum
Copper Oxychloride—less than	.50% maximum

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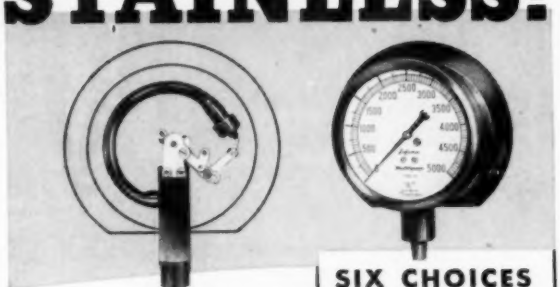
For samples make request on your company letterhead.

TENNESSEE TC CORPORATION

617-629 Grant Building, Atlanta, Ga.

STAINLESS!



—from inlet to tip

Now the superlative Mastergauge is available in a wider range of corrosion resistant tubes and sockets than any other pressure gauge.

Check the adjoining list. And remember that tube socket and tip are fused into one piece by the exclusive Marsh "Conoweld" process.

Marsh alone combines the "Conoweld" construction, the copper-clad "Marshalloy" case, the finer Mastergauge movement, the Marsh "Recalibrator", the new "Safecase." Ask for data covering your specific needs.

SIX CHOICES *of tubes and sockets*

4130 alloy steel tube with alloy steel tip and socket.

403 stainless steel tube with alloy steel tip and socket.

403 stainless steel tube with 416 stainless tip and socket.

316 stainless steel tube with alloy steel tip and socket.

316 stainless steel tube with 303 stainless tip and socket.

"K" Monel tube with alloy steel tip and socket.

MARSH INSTRUMENT CO., *Sales affiliate of Jas. P. Marsh Corp.* **Dept. 27, Skokie, Ill.**
Marsh Instrument & Valve Co., (Can.) Ltd. • 8407 103rd St., Edmonton, Alberta, Can.

MARSH "THE STANDARD OF ACCURACY"

What's New

kind of equipment. Each piece of equipment is shown in a drawing, all standard models are listed, and detailed costs are furnished in $/sq ft of transfer area, or some other convenient unit. Covered in the report are heat exchangers of the tube & shell, cubical, crossbore, plate and bayonet types, as well as cascade coolers, HCl absorbers, towers, centrifugal pumps, rupture discs, pipe fittings and valves. Fall Industries, Inc., Aurora Road, Solon, Ohio.

Circle No. **32** *on Reply Card*

Meter Catalog

. . . offers information for selecting oscillating piston meters: *Booklet 06 400 Rev. 6* is a newly revised bulletin that describes meters for measuring chemicals and industrial liquids. Contained are hints for selecting a meter, how to adjust meters, pressure loss curves and a recommendation chart for meter materials. Rockwell Manufacturing Co., 400 N. Lexington Ave., Pittsburgh 8, Pa.

Circle No. **33** *on Reply Card*

Wire and Cable

. . . for either underground or overhead use: *Form 663* is a 40-page bulletin covering type RR—rubber insulated—neoprene sheathed—non-metallic cables. Charts provide data on size, strand construction, insulation sheathing, outer diameter and shipping weights. Also included are data on current carrying capacities. National Electric Products Corp., Gateway Center, Pittsburgh 22, Penn.

Circle No. **34** *on Reply Card*

Controlling Corrosion

. . . with vinyl tape on overhead and underground piping: *Form No. 74-53* tells how Trantex polyvinyl tape protects and resists corrosion from weather, acids and alkalies, micro-organisms, soil chemicals and stray electrical currents. Specifications and resistance performance for both 10-mil and 20-mil tapes are given. Johns-Manville Dutch Brand Division, 7800 S. Woodlawn Ave., Chicago 19, Ill.

Circle No. **35** *on Reply Card*

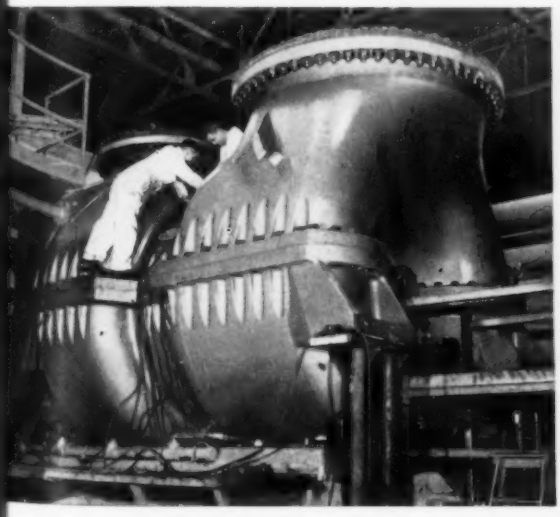
Annunciator System

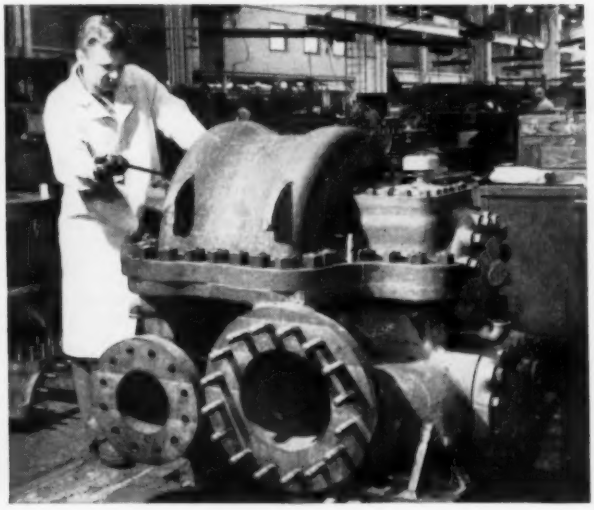
. . . for continuous supervision of control system and machinery: *Scam Self-Policing Annunciator Systems For Industry* is a catalog that contains information for selecting an alarm system. Included is a check list of factors to consider, plus engineering data to

Which is the best way to compress gas?

That depends. The compressor that's right for small volume flow isn't right for large volume flow—and vice versa. With the widest selection of compressors in the field, Carrier has the right unit for your process. Equally important, with greater experience handling more different gases in its compressors than any other manufacturer, Carrier offers application skill unmatched in the industry. Shown below are a Carrier Centrifugal Compressor for small volume flow and an Axial Flow Compressor for large volume flow. For complete information about them, call your nearest Carrier office.
Or write Carrier Corporation, Syracuse, New York.

Carrier



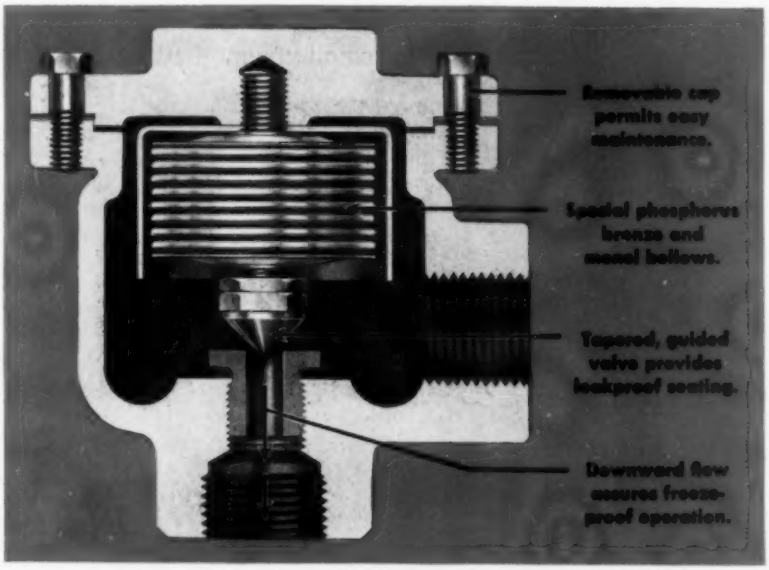


For large volume flow beginning at 75,000 cfm, Carrier Axial Flow Compressors are the answer. This unit, rated at 276,000 cfm, was made for use in a butadiene plant in the southwest. Carrier Axial Flow Compressors offer distinct advantages for large volume flow. Their high efficiency effects a significant reduction in operating costs. And their dependability is proved—the hundreds now in use have given reliable service for a total of over 60 million operating hours. Frame sizes are rated up to 600,000 cfm when operating on air.

For small volume flow starting at 1000 cfm, Carrier Centrifugal Compressors are the answer. This unit, the smallest in the Carrier centrifugal line, is installed in a refinery in Texas. Carrier has manufactured compressors that withstand pressures up to 2400 pounds, are driven with drivers of over 10,000 hp and attain extremely low temperatures. Their ability to run 24 hours a day, 7 days a week, year in and year out, is a matter of record, demonstrated in chemical, petrochemical and refinery processes in plants throughout the world.

ANDERSON PRESENTS...

THE GREATEST ACHIEVEMENT IN INDUSTRIAL THERMOSTATIC STEAM TRAPS


Removable cap permits easy maintenance.
Special phosphorus bronze and monel bellows.
Tapered, guided valve provides leakproof seating.
Downward flow assures freeze-proof operation.

NEW QUIK-FLEX

THERMOSTATIC STEAM TRAPS WITH THE FREEZE-PROOF GUARANTEE!

● Entirely new in design and engineering, here is one of the greatest achievements of all time in industrial thermostatic traps. Anderson's trap designers have engineered a trap that can be *guaranteed freeze-proof*—used with utmost safety in any outdoor or open-sided building installation. In addition, they are made with Anderloy valve and seat designed especially to resist scoring! Specify freeze-proof Quik-Flex Thermostatic Steam Traps.

THE V. D. ANDERSON COMPANY

Please send Bulletin 257 describing your new Quik-Flex Thermostatic Steam Trap with the Freeze-Proof guarantee.

Name _____

Company _____

Address _____

City _____ *Zone* ____ *State* _____

QUALITY STEAM TRAPS SINCE 1886

consider in designing an alarm system for relieving supervision of process monitoring duties. Scam Instrument Corp., 1811 West Irving Park Road, Chicago 13, Ill.

Circle No. **36** *on Reply Card*

Castable Refractories

. . . for high temperatures: *Bulletin 1992* contains technical information on Alundum 33-1, a lightweight insulating castable for protection up to 3300°F; and Alundum 33-HD, a heavy duty castable made primarily of pure aluminum oxide in dense grade form. Norton Company, Worcester 6, Mass.

Circle No. **37** *on Reply Card*

Packless Valves

. . . for applications involving hazardous liquids and gases: *Catalog F, Packless Valves,* is a 22-page bulletin describing in detail the use of metal bellows to eliminate conventional packing material. Cutaway views show many packless valve models in color. A chart lists the resistance of various metals used in these valves to the corrosive action of more than 200 different chemicals and gases. Fulton Sylphon Div., Robertshaw-Fulton Controls Co., Box 44, Knoxville 1, Tenn.

Circle No. **38** *on Reply Card*

Dust Control

. . . for industrial applications: *Bulletin No. 922* is a reference publication that describes the importance of dust control in industry and lists several methods for this control. Cloth screen collectors, cloth bag and screen collectors, and centrifugal wet collectors are pictured and described. Pangborn Corporation, Hagerstown, Md.

Circle No. **39** *on Reply Card*

Did You Miss These

The following items, reviewed originally in September, have aroused considerable interest among readers. They are repeated here briefly as a service to those who might have missed them the first time they appeared. For details or literature, please use the regular Reply Card in this issue.

Mobile Chromagraph

. . . is completely self-contained and occupies a floor space of only 30 x 26 in., exclusive of the carrier gas tank. The Model 1111A Chromagraph

Problem: Lengthen time between turnarounds...

Raise production...

Solution: Ljungstrom® Air Preheater

ith a Ljungstrom stills stay on stream at top capacity nths longer, because preheated air mixes more thorghly with fuel. More complete combustion greatly reces slag forming material. You generate higher flame mperatures, increase heat-transfer rates.

That's why four of your present processing units can the work of five. With Ljungstrom Air Preheaters each it's output can increase as much as 25%. Example: One e still in an eastern refinery went from 12,000 barrels 18/20,000 barrels after application of a Ljungstrom.

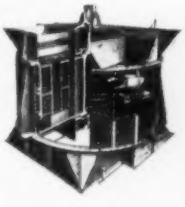
How fast is "WRITE OFF"?

ungstrom has many other advantages. You save up to % in fuel... furnace design is more economical, with need for convection surfaces... many fuels you used to throw away can be used... through-put is consistently improved... product quality is higher. You can see, therefore, why a Ljungstrom is paid out in nine months or less.

For more complete details on what the Ljungstrom Air Preheater can do for you – for an analysis of the heat recovery benefits attainable in fuel burning equipment – call or write The Air Preheater Corporation.

Wherever You Burn Fuel, You Need Ljungstrom

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.



he Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

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—how they are made
—how to design them
—where they are used
—how to handle them
—how much they cost

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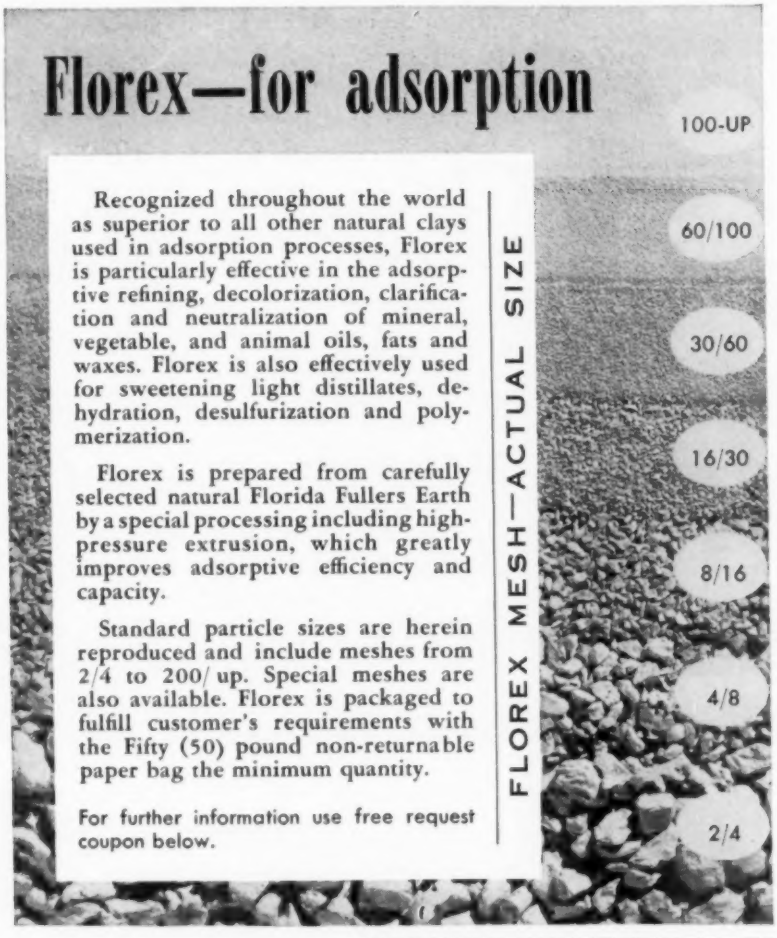
Florex is prepared from carefully selected natural Florida Fullers Earth by a special processing including high-pressure extrusion, which greatly improves adsorptive efficiency and capacity.

Standard particle sizes are herein reproduced and include meshes from 2/4 to 200/ up. Special meshes are also available. Florex is packaged to fulfill customer's requirements with the Fifty (50) pound non-returnable paper bag the minimum quantity.

For further information use free request coupon below.

FLOREX MESH—ACTUAL SIZE



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sample ☐ of Florex
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What's New

embodies many features evolved in several years of reasearch by Shell Development Co. Separation of isomers is readily handled at temperatures down to zero °C with a self-contained refrigerating unit. Materials boiling at temperatures approaching 400°C can be analyzed at operating temperatures of 250°C and higher.

The instrument has been successfully applied to the analysis of full-range cracked gas, other saturated or aromatic compounds, oxygenated and halogenated compounds, various alcohols and aldehydes, light aliphatic acids and esters, and other frequently used compounds.

Any column size up to 50 ft of ¾-in. diameter tubing can be accommodated. Carrier gas pressure is adjustable from 0 to 30 psig with self-contained regulator and pressure gage. A special electronic strip chart recorder of 1 mv sensitivity and 2-second pen speed is provided. Hallikainen Instruments, 1341 Seventh St., Berkeley 10, Calif.

Circle No. **40** *on Reply Card*

Corrosion Tester

. . . measures rate of corrosion of liquids and gases on all types of metals. In the space of a few hours it is possible to predict corrosion that may require five or ten years under actual conditions.

Basically, the instrument is a sensitive Wheatstone bridge circuit. Probes have one protected corrosion strip and exposed strip. The corrosion on the unprotected strip is indicated directly on the meter in micro-inches. The probes are designed for either high or low temperature testing, lab or field location, either short or long test periods.

All controls are housed in a steel case, fully enclosed from corrosive atmospheres. Standard models are wired for 115 volts, 60 cycles ac but may be obtained with a dc converter for field work. Labline Inc., 3070-82 W. Grand Ave., Chicago 22, Ill.

Circle No. **41** *on Reply Card*

High Vacuum Distillation

. . . for separation of materials with molecular weights above 250: *Rota-Film Still* is a 14-page brochure describing the construction features and special applications of this type of distilling equipment.

This unit permits commercial processing of higher molecular weight and heat sensitive materials, without losses due to side reactions such as

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Scovill Manufacturing Company, Mill Products Division, 99 Mill Street, Waterbury 20, Connecticut. Phone PLaza 4-1171.

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ISC57

NEW

Arnold O. Beckman Gas Density Balance

...for continuous, accurate measurement of process gas streams

Arnold O. Beckman, Inc., announces their new Gas Density Balance designed and constructed for rugged industrial use. This new instrument—known as the Model 3A—gives more sensitive, more versatile and more convenient readings than *any* gas density measuring unit now in use. The Model 3A is not only suited for specific gravity measurements of process streams, but also performs equally well for quantitative measurements of natural gas, H_2, CO_2 or other gases. The Model 3A is a null-balance type instrument which measures gas density by a direct physical principle, assuring rapid and accurate readings.

HERE ARE A FEW OF ITS MANY OUTSTANDING FEATURES . . .

Ranges: Single or multiple ranges with spans from 0.05 to 5.0 sp. gr. relative to air.

Rapid Response: 95% of any reading in less than one minute.

Sensitivity and Accuracy: ±½% of full scale.

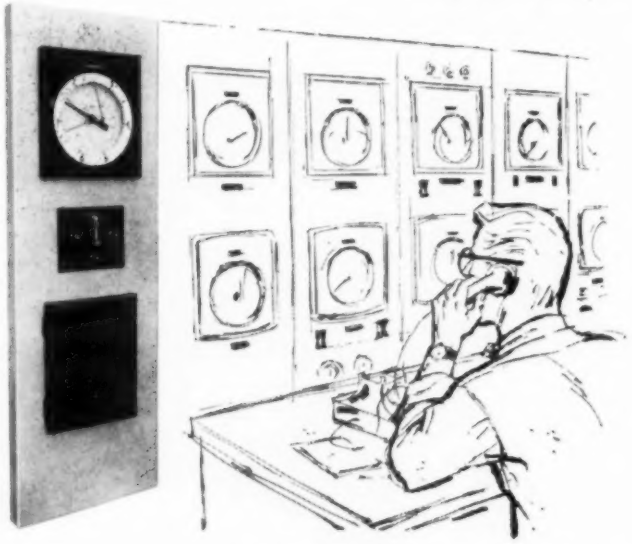
Corrosion Resistant: Measuring element protected against corrosive elements.

Output: 0-5 millivolts standard for use with potentiometer type recorders. Current or pneumatic output available with instruments having single ranges, or two or more ranges having a common end point.

Sample Required: 48 cubic inches per minute at 10 psi.

Power Required: 130 watts with 115 volts, 60 cycles.

The Arnold O. Beckman Gas Density Balance is a single compact unit, designed for wall or flush mounting. The standard steel case is vapor tight, thermally insulated and controlled so that operation is unaffected by ambient temperature changes. The unit weighs about 65 lbs. Explosion-resistant cases are also available.



For more information on the Model 3A Density Balance write directly for Data File 22J-27

Arnold O. Beckman INC.

1020 MISSION STREET • SOUTH PASADENA, CALIFORNIA

polymerization and cracking. Included in the bochure are pictures of a typical installation, and a vapor chart for many common low pressure vapor materials. Arthur F. Smith Co., Rochester 3, N. Y.

Circle No. **42** *on Reply Card*

Nondestructive Testing

. . . an overall look: *Seeing Isn't Always Believing* is a booklet (new edition) that describes the use of magnetic and other methods for detecting flaws in metal equipment. Methods explained include magnetic dusting, fluorescent magnetic particles, electrostatically charged particles, fluorescent penetrants, eddy currents, and ultrasonic waves. Magnaflux Corporation, 7300 Lawrence Ave., Chicago 31, Ill.

Circle No. **43** *on Reply Card*

Mixing Liquids

. . . or liquids and gases: *Addendum No. 1, Technical Supplement HM* discusses the general theory of mixing, different classes of fluids and viscosities, continuous vs. batch mixing, and the advantages of continuous mixing. Featured is information on "Homomix," a continuous pipeline mixer that is available in capacities up to 15,000 gph. The 14-page supplement includes curves on size and capacity of the pipeline mixer, typical applications and design specifications. The American Well Works, Aurora, Ill.

Circle No. **44** *on Reply Card*

Aluminized Fabric

. . . protects workers from intense heat encountered in emergency repairs, fire fighting or specific hot jobs. A recent demonstration showed that a suit of the material would protect a person walking into a furnace at 1,200°F.

The high-temperature suit is made of a fiber-glass material coated with aluminum and backed up with fiber-glass quilting. Nine-tenths of the heat is reflected away by the outer aluminum coating, while the heat that does get through is dissipated by the layer of glass fiber quilting.

The new fabric has been evaluated in more than 2,000 garments in industrial plants during the past year and has been used in emergency repairs of hot equipment. Many articles of clothing made from the fabric are now available. The aluminizing process is done by Minnesota Mining and Manufacturing Co., 900 Fauquier St., St. Paul 6, Minn.

Circle No. **45** *on Reply Card*

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(Chief Technical Subsidiary-Standard Oil Company (New Jersey))
Esso Research Center, Employee Relations-C
P. O. Box 51, Linden, N. J.

EDITORIALS . . .

Now they bark; next they'll bite

ANY petroleum processor who still thinks smog is a problem peculiar to Los Angeles, and one about which he need not be concerned, should know what's happening around New York City.

A group of municipal authorities in that area has recently approved in principle an idea for setting up an emergency air pollution control organization. It would have broad police powers for taking quick action during periods of smog.

The proposal is the work of the Metropolitan Regional Conference set up last June to cope with common problems in the tri-state metropolitan area around New York City, which includes parts of the states of Connecticut, New Jersey and New York. A number of refineries and petrochemical plants are in the area, such as those at Linden, Bayonne, and Perth Amboy (all in New Jersey), and at Brooklyn and Staten Island (New York).

Sixty-five municipal officials attended the Regional Conference meeting last December, and heard a report by the Conference's Air Pollution Control Committee. That group proposed that an emergency air pollution control organization be set up within the Regional Conference, and that it have power to enforce the closing of industries causing air pollution in times of temperature inversion.

Such powers would require action by the individual state legislatures. Accordingly, the Conference approved a recommendation to the legislatures asking for authority to set up county air pollution commissions with power and funds to enforce rules. It also approved a proposal calling for the elimination of automobile exhaust fumes—now accepted in Los Angeles as a major contributor to smog.

Chairman of the Air Pollution Control Committee, by the way, is a Mr. Karl Metzger, who is also director of the Middlesex County (N. J.) Board of Freeholders. There's a good-sized refinery in Middlesex County—at Perth Amboy.

We don't anticipate that the Regional Conference's recommendations will get very far—at least not in the near future. But its actions do seem to emphasize the points we've made in the past:

1—Smog is NOT confined to Los Angeles.

2—Petroleum processors throughout the world should study their own atmospheric emissions, and do something to correct them where necessary.

3—They should do it voluntarily and in the way they want to, before they are forced to do so—and are told what and how to do it.

4—The industry must be on the alert to prevent local politicians from making a political issue of smog—with the resulting unrealistic and discriminatory legislation.

Acting like the three monkeys who "see no evil, hear no evil, speak no evil" is nothing less than sheer stupidity. If you're polluting the air, stop it!

Big business isn't bad business

WE WANT to commend two companies for recent contributions they have made toward a better understanding of our industry:

Gulf Oil Corp.—for its booklet "The Industry Nobody Really Knows," aimed at giving people a more realistic understanding of how the oil industry actually gets its job done. This 32-page story makes interesting reading—even for someone who thinks he already knows the industry. And it gives some good arguments to toss back at the fellow who says the large oil company is just a giant octupus squeezing out the little guy. (Want a free copy? Circle No. 99 on this month's Reader Service Reply Card, or write to Gulf, PO Box 1166, Pittsburgh 30, Pa.

DuPont's Petroleum Chemicals Div.—for its newest lecture demonstration—"A 'Brief' Case for Business." Using illustrations largely from the petrochemical field, the "Brief" Case explains the role of big business in our economy. It brings out how large companies build opportunities for small ones by undertaking the jobs little ones can't afford to do—such as research, while at the same time big firms depend on many small firms for some of their essential operations which small firms are better qualified to perform. "A 'Brief' Case for Business" is being made available through the national Oil Industry Information Committee as a supplement to DuPont's famous "Magic Barrel."